

A REVIEW OF BORNEAN ZINGIBERACEAE: I (ALPINEAE p.p.)

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ABSTRACT. Keys to the Bornean genera of subfam. Zingiberoideae tribe *Alpineae* are given and five genera, *Burbidgea*, *Plagiostachys*, *Alpinia*, *Hornstedtia* and *Amomum* reviewed, together with keys to the species. 13 new species are proposed: *Plagiostachys bracteolata*, *Alpinia martinii*, *Hornstedtia lanata*, *Amomum lambirense*, *A. ligulatum*, *A. burttii*, *A. pungens*, *A. hansenii*, *A. paucifolium*, *A. gyrolophos*, *A. longipedunculatum*, *A. luteum* and *A. flavidulum*; also two new varieties: *Alpinia glabra* var. *reticosa* and *Hornstedtia pininga* var. *borneense*.

GENERAL INTRODUCTION

In a previous paper (Smith, *Bot. J. Linn. Soc.* 85:36-73, 1982) the Zingiberaceae of the Gunung Mulu National Park in the 4th Division of Sarawak were reviewed and 14 new species described. The present work will, it is hoped, be the first in a series covering the family in Borneo as a whole but with special reference to Sarawak and Sabah whence much good recent material has come. Many problems remain unsolved and the difficulty in elucidating genera such as *Zingiber*, *Globba* and *Plagiostachys* is self-evident in these accounts. Nonetheless, it is now almost 80 years since Ridley's Scitamineae of Borneo was published (*J. Str. Br. Roy. As. Soc.* 46:229-246, 1906) and this very imperfect work can be of little use to present day botanists. Future ginger enthusiasts, particularly those in the field, have need of a basis on which to build (or alter as they see fit), and it is the intention of this series to provide just such a starting point.

The Zingiberaceae is subdivided into two subfamilies, the Zingiberoideae, which comprises four tribes and the Costoideae (sometimes treated as a separate family). All are represented in Borneo and their salient characters are set out below. This first paper deals with *Burbidgea*, *Plagiostachys*, *Alpinia*, *Amomum* and *Hornstedtia*, that is, much the larger portion of the tribe *Alpineae*; in succeeding parts every effort will be made to follow the order as listed here.

Subfam. Zingiberoideae

Leaves distichously arranged, sometimes appearing tufted or leaf shoots single leaved.

Tribe Alpineae

Plane of distichy transverse to rhizome; ovary trilocular, placentation axile; lateral staminodes much reduced or absent.

Inflorescence terminal on leaf shoot.

Burbidgea, *Plagiostachys*, *Alpinia*.

Inflorescence radical.

Hornstedtia, *Amomum*, *Nicolaia*, *Achasma*, *Geanthus*, *Elettariopsis*, *Elettaria*, *Geostachys*.

Tribe **Hedychieae**

Plane of distichy of leaves parallel to rhizome; ovary trilobular, placentation axile, or unilobular; lateral staminodes petaloid.

Hedychium, Camptandra, Boesenbergia, Scaphochlamys, Kaempferia.

Tribe **Globbeae**

Plane of distichy of leaves parallel to rhizome; ovary unilobular, placentation parietal; anther long exerted on an arched filament.

Globba.

Tribe **Zingibereae**

Plane of distichy of leaves parallel to rhizome; ovary trilobular, placentation axile; anther-crest wrapped round the exerted style.

Zingiber.

Subfam. **Costoideae**

Leaves spirally arranged.

Costus.

Note: Plane of distichy of the leaves, Fig. 1.

This character is, of course, virtually unusable when dealing with herbarium material. Field observations indicate that it is a reliable distinguishing feature, but it is often difficult to check when dealing with small tufted plants with short rhizomes such as *Kaempferia* and *Boesenbergia*.

TRIBE ALPINEAE

A. *Inflorescence terminal on the leaf shoot*

KEY TO THE GENERA

1. Labellum narrow, no wider than and held erect against the stamen; flowers plain yellow-orange, unmarked 1. *Burbidgea*
+ Labellum never as above; flower colour various, always with some form of patterning on the labellum 2
2. Inflorescence breaking through the leaf-sheaths laterally (but actually terminal), densely congested and often becoming mucilaginous; labellum not or barely exceeding the petals 2. *Plagiostachys*
+ Inflorescence emerging above the uppermost leaf sheath, rarely appearing lateral and if so then not densely congested and labellum large and showy 3 *Alpinia*

1. *Burbidgea* Hook. f. in Bot. Mag. t. 6403 (1879); Smith in Notes RBG Edinb. 31:297 (1972).

Burbidgea, which is endemic to Borneo, is a very natural genus, characterized by the orange-yellow (occasionally pink-tinged) flowers and by the small narrow labellum which is held erect against the stamen, its base joining with the filament to form a very short tube above the petals. Unlike the majority of the Zingiberaceae, the petals are the most conspicuous feature of the flowers. These flowers are borne singly or in

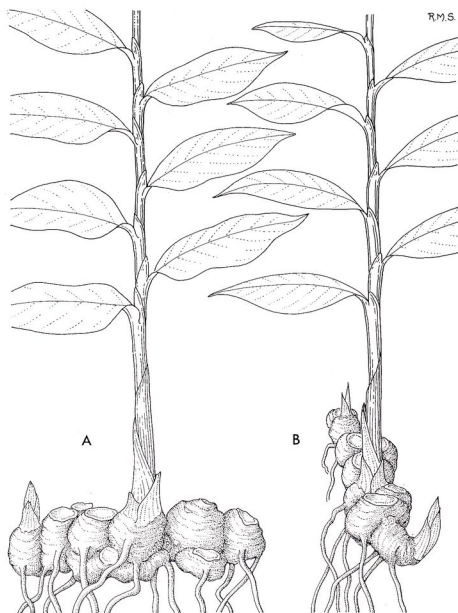


FIG. 1. Rhizomes, showing plane of distichy of leaf shoots. A, parallel (*Hedychieae*, *Globbeae*, *Zingibereae*); B, transverse (*Alpineae*).

pairs on the unbranched rhachis and are at first protected by quickly deciduous, papery bracts.

KEY TO THE SPECIES (revised since 1972)

1. Dorsal petal broadly elliptic; labellum petaloid at apex; ligule under 5mm long..... 2
- + Dorsal petal elliptic; labellum not petaloid at apex; ligule up to 3cm long, but may be much less in *B. stenantha*..... 4
2. Leaves usually c.12 times as long as broad; inflorescence 2-7-flowered
3. *B. pauciflora*
- + Leaves usually not more than 4 times as long as broad (rarely as much as 8); inflorescence copiously flowered..... 3
3. Leaves quite glabrous; dorsal petal non-cucullate; ovary without conspicuous glands..... 1. *B. nitida*
- + Leaves densely pubescent on the midrib or entire surface below; dorsal petal shortly cucullate; ovary conspicuously gland dotted. 2. *B. longilora*
4. Leaves sessile, very long caudate, ligule not exceeding 1cm.....
4. *B. stenantha*
- + Leaves distinctly petiolate; shortly caudate or acute; ligule 1.5-3cm long..... 5. *B. schizocheila*

1. *Burbidgea nitida* Hook. f. in Bot. Mag. t. 6403 (1879); Smith in Notes RBG Edinb. 31:299, fig. 1A (1972).

Type: Sarawak, 5th Division, between Lawas and Trusan rivers, *Burbidge*, Hort. Veitch. cultivated material only, 1978 (K).

B. nitida was reported by its collector to be 'very local'. No further material has been seen.

2. *Burbidgea longilora* (Ridley) R. M. Smith, op. cit. 300, fig. 1C.

Type: Sarawak, 1st Division, Puak, *Brooks* s.n. (BM).

Syn.: *Alpinia longilora* Ridley in J. Bot. 51:247 (1913).

Langas longilora (Ridley) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929).

Recent material:

SARAWAK: 4th Division, G. Mulu National Park, G. Mulu, 5 ii 1978, *Nielsen* 263 (AAU).

This collection differs from the type in the entirely pubescent lower leaf surface.

3. *Burbidgea pauciflora* Val. in Ic. Bog. 3: t. 203 (1906); Smith, op. cit. 299, fig. 1B.

Type: Borneo, without precise locality, *Nieuwenhuis* s.n., Hort. Bogor (n.v.).

Recent material seen:

SARAWAK: 7th Division, Belaga district, Linau-Balui divide, Sungei Nawai, 2600ft, epiphyte, 5 ix 1978, *Burt* 11446 (E).

A collection from the G. Mulu National Park, *Collenette* 2341 (K) deviates in the shorter and wider leaves.

4. *Burbidgea stenantha* Ridley in J. Bot. 75:202 (1937); Smith, op. cit. 302, figs 1D, 2B.

Recent material seen:

SARAWAK: 4th Division: G. Mulu National Park, near Melinau gorge, camp 5, lowland alluvial rain forest, c.150m, epiphyte, 4 v 1978, *Argent & Coppins* 1149 (E); G. Subis, Miri District, on vertical limestone, rooting in crevices, 24 iv 1972, *Anderson* S31669 (E). 7th Division, Belaga District, Linau-Balui divide, Sungei Nawai, foot of tree by river, c.2600ft, 5 ix 1978, *Burt* 11445 (E).

5. *Burbidgea schizocheila* Hackett in Gard. Chron. 36:301 (1904); Wright in Bot. Mag. t. 8009 (1905); Smith, op. cit. 301, fig. 1F.

Type: Borneo, without precise locality, hort. Kew from Buitenzorg Botanic Garden, 1903 (K).

Syn.: *B. pubescens* Ridley in J. Bot. 75:203 (1937); R. M. Smith, op. cit. 304, figs 1E, 2A. Type: Sabah, Mt Kinabalu, Kiau, *Clemens* 9939 (K).

Recent material seen:

SARAWAK: 4th Division, G. Mulu National Park, Hidden valley, camp 6, c.450m, epiphyte on tree in lowland alluvial rain forest between limestone cliffs, 5 iv 1978, *Argent et al.* 884 (E).

SABAH: near top of pass, Kimanis to Kenigau road, c.1300m, terrestrial, 27 iii 1980, *Argent* 1568 (E).

B. schizocheila has a more robust habit and generally larger leaves than *B. stenantha* but specific limits within *Burbidgea* are not easy to define and the two probably intergrade.

During the last few years, cultivated material of *B. schizocheila*, from Potsdam and Longwood Botanic Gardens (both distributed as *B. nitida*) has flowered at Edinburgh and, although showing less inflorescence pubescence than that of Ridley's plant, indicate that there is no justification for maintaining *B. pubescens*. It has also been observed that, in cultivation, *Burt & Martin* B 5314 from G. Murud which was placed in *B. pubescens* in 1972, tends to a much more glabrous habit when compared to the wild collection.

2. *Plagiostachys* Ridley in J. Str. Br. Roy. As. Soc. 32:151 (1899).

The mucilaginous nature of the inflorescence in many species of *Plagiostachys* makes critical study of the genus from herbarium material difficult. The following notes are, therefore, little more than a survey of recent collections; this has been made possible only because several of these have been accompanied by spirit material.

Plagiostachys is characterized by the manner in which the inflorescence, although actually terminal on the leaf-shoot, is pushed out laterally, sometimes at ground level, through the sides of the leaf-sheaths. The flowers are densely congested on the main axis—which may be simple or bear one or two branches at the base—and each is subtended by a usually tubular bracteole; rudimentary bracts have been observed in a single collection; cincinni are unknown.

Holtum (*Gard. Bull. Sing.* 13:161, 1950) considered *Plagiostachys* to be most closely allied to *Amomum* and indeed several *Amomum* are known to

produce mucilaginous inflorescences, but the affinity may equally well lie with *Alpinia* and in particular with *A. hansenii* and *A. havilandii*, which also have apparently laterally produced inflorescences and differ from the non-mucilaginous species of *Plagiostachys* only in the absence of persistent bracteoles, in having less congested inflorescences and a large, showy labellum. Future field study will verify if a lateral inflorescence is a constant feature of *A. hansenii* and *A. havilandii*, but their very existence underlines the need for reassessment at generic level in some groups of the Zingiberaceae.

Plagiostachys is distributed throughout Malaysia, Indonesia and the Philippines; a single species has been described from China.

In the main, Bornean *Plagiostachys* falls into two natural groups which may be distinguished as follows:

Group I. Plants with mucilaginous inflorescences; the bracteoles distinctly tubular, early decaying, only the very basal part remaining; calyx fleshy, decaying in the upper part at least; style sometimes adnate to the wall of the corolla-tube above the epigynous glands; capsule oblong-pyriform, angled, rarely globose. Ligule bilobed. Flowers yellow and white with some pink.

Group II. Plants with non-mucilaginous inflorescences; the bracteoles tubular at base or open, partially decaying or persistent; calyx not fleshy, not decaying; style usually free from the wall of the corolla-tube at the base; capsule globose. Ligule truncate or emarginate rarely bilobed. Flowers pinkish-red with a yellow labellum.

KEY TO THE SPECIES

1. Inflorescence mucilaginous (Group I)..... 2
- + Inflorescence non-mucilaginous (Group II)..... 4
2. Leaves up to 1.5m long, inflorescence elongating to c.30cm with age; bracteoles with a long fleshy apical beak which decays well before anthesis..... 1. *P. crocydocalyx*
- + Leaves up to 0.8m long; inflorescence sometimes elongating to 15cm; bracteoles not as above..... 3
3. Leaves glabrous; petioles 2.5-6cm long; anther-connective truncate; capsule oblong-pyriform..... 2. *P. albiflora* s.l.
- + Leaves with some pubescence, sessile or petioles under 2cm; capsule usually globose..... 3. imperfectly known mucilaginous species
4. Bracteoles long apiculate, open to the base, persistent; style adnate to the wall of the corolla-tube above the epigynous glands
4. *P. bracteolata*
- + Bracteoles not long apiculate, tubular at the base initially, showing some decay in upper part; style free to base or very shortly adnate below the epigynous glands..... 5
5. Ligule bilobed, to 1.5cm long; lateral staminodes oblong. 5. *P. sp. nov.?*
- + Ligule truncate or emarginate, 2-3mm long; lateral staminodes linear..... 6
6. Leaves sessile; anther connective truncate..... 6. *P. strobilifera*
- + Leaves with petioles up to 3cm long; anther-connective distinctly crested..... 7. *P. sp.* (aff. *strobilifera*)

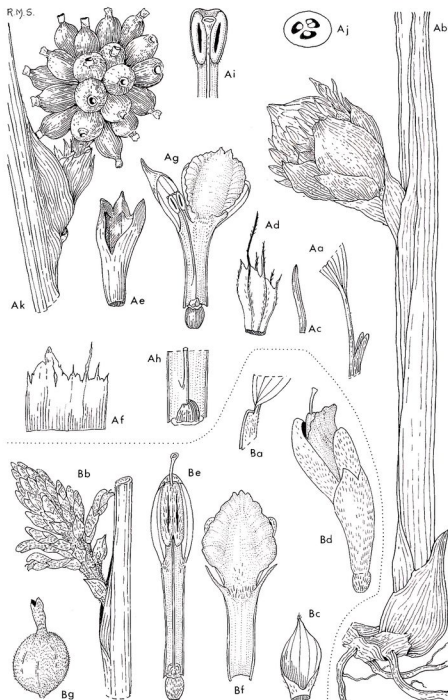


FIG 2. A. *Plagiostachys albiflora*. Aa, ligule and base of leaf $\times \frac{2}{3}$; Ab, young inflorescence emerging from leaf sheaths $\times \frac{2}{3}$; Ac, rudimentary bract $\times 2$; Ad, decaying bracteole $\times 2$; Ae, calyx $\times 2$; Af, calyx, dissected $\times 2$; Ag, flower, dissected $\times 2$; Ah, base of corolla tube showing adnate style and epigynous glands $\times 4$; Ai, stamen and stigma $\times 4$; Aj, ovary in T.S. $\times 6$; Ak, infructescence $\times \frac{2}{3}$. (Aa from dried material of *Burt & Martin* B5505; Ab-Ak from spirit material of *Burt & Martin* B4793). B. *Plagiostachys strobilifera*. Ba, ligule and base of leaf $\times \frac{2}{3}$; Bb, young inflorescence $\times \frac{2}{3}$; Bc, bracteole $\times 2$; Bd, flower $\times 2$; Be, Bf, flower dissected $\times 2$; Bg, capsule, surmounted by intact calyx $\times 1$. (Ba, Bc-Bf from spirit material of *Hansen* 266; Bb, reconstruction, based on dried material of *Hansen* 266 & *Argent et al.* 909; Bg from dried material of *Burt* 11588).

1. *Plagiostachys crocydocalyx* (K. Schum.) Burt & Smith in Notes RBG Edinb. 31:315 (1972). Fig. 2B.

Syntypes: Sarawak: 1st Division, Siul, near Kuching, x 1865, *Beccari* s.n. (n.v.); Marop, Batang Lupar, v 1867, *Beccari* 3477 (FI, K).

Syn.: *Alpinia crocydocalyx* K. Schum. in Bot. Jahrb. 27:281 (1899) & Pflanzenr. Zing. 310 (1904).

Languas crocydocalyx (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929)—sphalm. *crocodocalyx*.

Other material seen:

SARAWAK: 1st Division, Bau distr., Bukit Jebong, 150ft, in secondary jungle in limestone derived soil, wet, very pungent smell, flowering part of inflorescence with much mucus, yellow throat to flower, 6 vii 1970, *Lehmann* S30145 (E); Semengoh Forest Reserve, *George* 892 (E); 7th Division, Ulu Belaga, Sungai Semawat, 250m, hill dipterocarp forest, open area on slope where trees had fallen, bracts of inflorescence below flowers totally mucilaginous, a process already starting above level of flowering, flowers pale yellow, 20 x 1981, *Hansen* 726 (C).

P. crocydocalyx stands apart from all other *Plagiostachys* in its immense size; plants may reach 5m in height with leaf blades of up to 1.5m and correspondingly large inflorescences. The fleshy 'beaked' bracteoles lie tightly pressed against each other in the young inflorescence; these and the calyx become mucilaginous very quickly. This mucilage has been graphically described by Beccari in his *Wanderings in the forests of Borneo (Nelle Foreste di Borneo)* as 'a sort of putrescent slime . . . in which an enormous number of *Coleoptera* seek refuge'. The globose capsules are shortly pubescent. The leaves are softly and densely hairy below; this indumentum, in the dried state at least, takes on an attractive golden hue.

2. *Plagiostachys albiflora* Ridley in J. Str. Br. Roy. As. Soc. 50:150 (1908); Holttum in Gard. Bull. Sing. 13:164 (1950). Fig. 3A.

Type: Malay Peninsula, Johore, Kukub, *Ridley* 1336 (K).

The following Bornean material may belong here:

SARAWAK: 1st Division: G. Berumpet, Poi Range, c.3500ft, granite rock in gully, yellowish flower with scarlet lines on lip, 13 viii 1962, *Burt & Woods* B2818 (E); *ibidem*, upper petal pink at edges, otherwise more or less translucent, cucullate, labellum yellow with red branched lines, 13 viii 1962, *Burt & Woods* B2808 (E); G. Beiran, Padawan distr., flowers white with faint flush of pink, 14 v 1975, *Burt* 8144 (E). 4th Division: G. Mulu National Park, E of Melinau Gorge, *Hansen* 290 (C). 5th Division, Bakelan to Mt Murud, Long Rapata near camp 2, forest near streamside, flowers cream except for labellum which is yellow with red veins, 14 x 1967, *Burt & Martin* B5505 (E). 7th Division: Hose Mts, cliffs below B. Mabong, labellum orange with transverse wavy lines along margin, 5 viii 1967, *Burt & Martin* B4793 (E); S Hose Mts, below B. Salong, W side, steep earth banks in gully, inflorescence breaking through sheath just below ground level so that fruits partially buried, lip yellow in centre, 25 iii 1980, *Burt* 12698 (E).

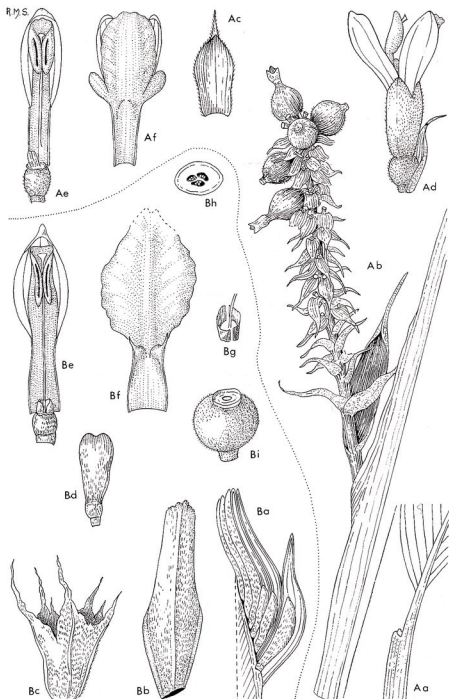


FIG. 3. A. *Plagiostachys bracteolata*. Aa, ligule and base of leaf $\times \frac{2}{3}$; Ab, inflorescence $\times \frac{2}{3}$; Ac, bracteole $\times 2$; Ad, flower and bracteole $\times 2$; Ae, Af, flower dissected $\times 2$. (Aa, Ab reconstructed from dried material of *Burt & Martin* B5429; Ac-Af from spirit material of *Argent & Lamb* 1529). B. *Plagiostachys crocydocalyx*. Ba, upper part of young inflorescence in L.S. showing tubular 'beaked' bracteoles and young buds $\times 1$; Bb, bracteole, apex showing signs of decay $\times 1$; Bc, decaying bracteole from flower just before anthesis $\times 1$; Bd, young bud, enclosed by fleshy calyx $\times 1$; Be, Bf, flower, dissected $\times 1$; Bg, base of style and epigynous glands $\times 2$; Bh, ovary in T.S. $\times 2$; Bi, capsule $\times 1$. (All from spirit material of S30145).

Several of the above differ from the type collection of *P. albiflora* in the shorter, narrower leaves and there is also variation in the amount of reticulation found on the leaf sheaths. The Imm anther crest attributed to the peninsular plants is also lacking. However, in other floral detail, the distinctly petiolate leaves, bilobed ligule and oblong capsules they match *P. albiflora* well. Rudimentary bracts have been observed in *Burt & Martin* B4793.

A constant feature of the Bornean material, and one which it has not been possible to verify in the peninsular plants, is the manner in which the style is adnate to the wall of the corolla-tube just above the epigynous glands. This easily overlooked character, which has apparently not been observed hitherto, is absent from *P. crocydocalyx*.

3. Imperfectly known mucilaginous species.

i. SARAWAK: 1st Division, Semengoh Forest Reserve, 10 x 1967, *Burt & Martin* B5616 (E).

This collection, which is in fruit, must lie close to *P. albiflora*. It differs in the shorter, broader capsules and sessile leaves which bear conspicuous marginal hairs.

ii. SARAWAK: 1st Division, Semengoh Forest Reserve, 24 viii 1967, *Burt & Martin* B4718 (E).

This may represent a new species, but much inflorescence detail cannot be distinguished. The plant is not unlike *P. crocydocalyx* but is very much smaller in all parts, has an adnate style base and leaves which are pubescent on both surfaces.

iii. SARAWAK: 1st Division, Bukit Jebong, Bau distr., on alluvial soil under low secondary jungle canopy, 150ft, young leaves red, fruit red turning brown, 8 viii 1970, *Lehmann* S29434 (E).

Here the young fruits are globose and shortly pubescent, exactly as in *P. crocydocalyx*. It is, however, a much smaller plant, the leaves only slightly hairy on the lower surface. No flowers have been seen and it is tentatively placed with the mucilaginous species.

4. *Plagiostachys bracteolata* R. M. Smith, species nova inflorescentia non-myxogena, antherae crista truncata, capsulis rotundatis *P. strobiliferae* similis, sed ob folia petiolata, staminodia oblonga, bracteolas longe apiculatas distinguenda. Fig. 2A.

Statura ignota. *Folia* 25-50 x 7-8cm, lanceolata, longe acuminata, subtus minute pubescentia; petioli 1.5-2.5cm, parce pubescentes; ligula 2-3mm, emarginata, parce pubescens; vaginae parce pubescentes. *Inflorescentia* lateraliter emergens, 12 x 4cm, cylindrica, ad 18cm infructu elongata, pubescens, bracteis 2-3 vaginantibus basi praedita; bracteolae 1.5-3cm longae (apicem versus minores), ovato-oblongae, apice 3-5mm apiculatae, pubescentes, persistentes, numquam dissolutae. *Flores* albi, corolla c.1.5cm longa, tubo calyci brevior, lobis c.0.8-1cm longis dorsali breviter cucullato; staminodia lateraliter 4mm longa, oblonga; labellum 1cm longum, oblongum, carnosissimum, flavum pallide rubronotatum; stamen 1-1.2cm longum, filamento antherae aequali, connectivo truncato leviter

undulato; stylo ad parietem tubi corollini per 2mm basalia connato; glandulae epigynae 2mm, crassae, inter se liberae. *Fructus* globosus collo brevi, breviter pubescens.

Type: Sabah, G. Lumarku, near Sipitang, western path to summit, c.1500m, mossy forest, white inflorescence with red peduncle, flower white with yellow on labellum and faint reddish markings well inside throat, 22 iii 1980, *Argent & Lamb* 1529 (holo. E).

SARAWAK: 4th/5th Division boundary, Bakelalan to Mt Murud, near camp 4, in fruit, 7 x 1967, *Burt & Martin* B5429 (E).

P. bracteolata is unique among non-mucilaginous *Plagiostachys* in that, as in *P. albiflora*, the style is adnate to the wall of the corolla-tube just above the epigynous glands. The species may be recognized by the long apiculate non-tubular bracteoles which, although they may break off towards the tips, show no sign of decay and remain persistent on the infructescence. The petiolate leaves are minutely pubescent below and the truncate ligule is similar to that of *P. strobilifera*.

A collection from the 7th Division, S Jellini, Linau-Balui divide, *Burt* 11367 (E) may be nearly related. It is in bud only but the bracteoles seem to have long apiculate tips. They are, however, tubular at the base, and the shortly petiolate leaves have conspicuously shaggy sheaths and ligules.

5. *Plagiostachys* sp. nov.?

SARAWAK: 1st Division; G. Manok, Padawan distr., light yellowish pink flowers in flat topped head, 13 v 1975, *Burt* 8137 (E).

In the current state of knowledge of *Plagiostachys* it would be unwise to describe a new species based only on a single collection without mature fruit, but it seems highly probable that this material represents a new taxon, and one which may not fit conveniently into either of the groups defined above.

The inflorescence does not appear to be mucilaginous, but the bracteoles, which are initially tubular, disintegrate to a considerable degree. The calyx is thin textured and appears to remain whole, but there is no evidence from the very young capsules that it is persistent. The style is adnate to the corolla-tube below the epigynous glands and, consequently, appears quite free. There is a well-formed, rounded anther-crest, and the lateral staminodes are oblong, as in *A. bracteolata*. The sessile leaves are pubescent below and the prominent ligule bilobed.

6. *Plagiostachys strobilifera* (Bak.) Ridley in J. Str. Br. Roy. As. Soc. 32: 151 (1899). Fig. 3B.

Type: Sabah; near Sandakan, *Creagh* (K).

Syn.: *Alpinia strobilifera* Bak. in Kew Bull. 1898:325 (1898).

Alpinia brachypoda K. Schum. in Bot. Jahrb. 27:298 (1899) & Pflanzenz. Zing. 367 (1904). Type: Sarawak, Mt Matang, vii 1867, *Beccari* 3636 (FI).

Plagiostachys brachypoda (K. Schum.) Loesen., Pflanzenfam. 2 Aufl. 15a:628 (1930).

Plagiostachys borneensis Ridley in J. Str. Br. Roy. As. Soc. 46:242 (1906). Syntypes: Sarawak; Mt Matang, 1893, *Ridley* 11800 (K). Bau, *Ridley* s.n. (n.v.).

Languas brachypoda (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929).

Languas strobilifera (Bak.) Merr., op. cit., 35.

Other material seen:

SARAWAK: 1st Division: Bau distr., G. Tabai, near foot of hill, near Tai Ton mine, heads of deep pink flowers, about 9–12in above ground level, 18 v 1975, *Burt* 8164 (E); Lundu distr., G. Perigi, inflorescence breaking through sheath about 6in above base of leaf shoot, 6 viii 1962, *Burt* & *Woods* B2703 (E). 4th Division: G. Mulu National Park, c.900m, Hidden Valley eastern end, on shady bank in ridge forest, red, 6 iv 1978, *Argent et al.* 909 (E); G. Mulu National Park, 1978, *Hansen* 266 (C); Lambir National Park, ridge SW of Bukit Lambir, c.1100ft, flowers light red except for pale yellow toothed lip, 26 ix 1978, *Burt* 11632 (E); *ibidem*, Sungei Lapoh, streambank in forest, inflorescence, in bud, wholly light red, 9–12in above ground, 20 ix 1978, *Burt* 11551 (E).

SABAH: Kobon China Forest Reserve, flowers red and orange, 17 iii 1967, *Stone* 6700 (KLU); above Kallang waterfall, near Tenom, c.900m, lowland rain forest, flowering above second leaflet, flowers red with yellow labellum, *Argent* 1348 (E); Myburgh province, Sandakan, x–xii 1921, *Elmer* 20184 (UC); *ibidem*, *Elmer* 20346 (UC).

P. strobilifera may be recognized by the more or less sessile, lanceolate leaves which are always pubescent below and often bear scattered hairs on the upper surface, the very short (less than 4mm) truncate or emarginate pubescent ligule, and the hairy sheaths. The densely pubescent inflorescence may be simple or bear one or two lateral branches at the base. Well formed, usually linear, lateral staminodes are present, the anther-connective is truncate and the style free to the base.

Material from the 1st Division of Sarawak, including the types of *P. brachypoda* and *P. borneensis*, have rather broader leaves but cannot be otherwise separated from *P. strobilifera*.

Three further collections, *Burt* 8273 and *Argent & Kerby* 812 (both from Mulu National Park) and *Burt* 11588 (Lambir National Park), are identical in floral detail but differ in the entirely glabrous leaves and more or less glabrous sheaths.

7. *Plagiostachys* sp. (aff. *P. strobilifera*)

SARAWAK: 1st Division, Bau distr., G. Meraja, S of Bidi, flowers pink red, 17 v 1975, *Burt* 8155 (E); 3rd Division, Hose Mts, below Bukit Nibong, 2600ft, forest floor, inflorescence 6 inches above ground, flowers dull rose except for central yellow bar on lip, anther-crest rounded, 9 viii 1967, *Burt* & *Martin* B4873 (E).

These collections are very close to *P. strobilifera*, differing in the distinctly petiolate leaves and well-formed anther crest. More information on variation within species or species 'groups' in *Plagiostachys* should be obtained before any decision is taken on the status of these plants.

Excluded species:

P. polycarpa (K. Schum.) Loesen. = *Amomum polycarpum* (K. Schum.) R. M. Smith.

3. *Alpinia* Roxb. in *Asiat. Res.* 11:350 (1810) nom. cons.Syn.: *Catimbium* Lestib. in *Ann. Sci. Nat. sér. 2*, 15:346 (1841)—non Juss.*Languas* Small, *Fl. SEUS* ed. 2, 307 (1913).

Rather more than half of Bornean *Alpineae* with terminally produced inflorescences belong to the polymorphic *Alpinia*. This unwieldy genus is widely distributed throughout South East Asia and also extends to Japan in the north, and to the rain forest of Australia in the south. Its immense diversity of form is reflected, to a certain degree, in the Bornean element. Beyond commenting on the sectional position of the species within the terms of Schumman's existing, and rather unsatisfactory, arrangement, no attempt is made here to suggest an infrageneric classification for Bornean *Alpinia*. The herculean task of subdividing this enormous genus must await a monographer with knowledge (and time) enough to deal with it throughout its entire range.

KEY TO THE SPECIES

1. Bracts to 10cm long, quite concealing the flowers; inflorescence pendulous..... 1. *A. capitellata*
- + Bracts, when present, very much smaller, never concealing the flowers; inflorescence generally erect or, occasionally, pushed out laterally below the top of the leafy shoot..... 3
2. Bracteoles tubular, persistent; flowers in cincinni; labellum c.6mm long, obscurely 3-lobed..... 2. *A. sumatrana*
- + Bracteoles, if present, usually soon deciduous, open to the base or initially calyprate around the unopened flower; flowers in cincinni or not; lip over 1cm long, if less, then 4-lobed..... 3
3. Lip usually just under 1cm long, 4-lobed, the central sinus very deeply cleft..... 3. *A. aquatica*
- + Lip 1cm or more long, shape never as above..... 4
4. Inflorescence strongly paniculate; bracts calyprate* round the buds, soon deciduous, the bases sometimes remaining..... 5
- + Inflorescence simple or occasionally with one or two short lateral branches at the base; bracts, if present not calyprate..... 6
5. Ligule to 6cm long; calyx lobes prominently apiculate.... 4. *A. ligulata*
- + Ligule to 1.5cm long; calyx lobes not strongly apiculate
5. *A. nieuwenhuizii*
6. Flowers borne singly on the main axis; bracteoles absent; bracts quickly deciduous, usually only scars seen..... 7
- + Flowers in cincinni, if single then at the top of the inflorescence only; bracteoles present; bracts present or not..... 12
7. Anther ecristate..... 8
- + Anther with a well developed crest..... 11
8. Leaves pubescent below..... 9
- + Leaves glabrous below..... 10
9. Ovary yellow orange tomentose; ligule to 5mm long.... 6. *A. havilandii*
- + Ovary glabrous; ligule 2mm long..... 7. *A. ptychanthera*

*Care should be taken not to confuse the initially calyprate bracts of *A. ligulata* and *A. nieuwenhuizii* with the much larger calyprate bracteoles of *A. glabra*.

10. Leaves sessile, margins with widely spaced bristle-like hairs; flowers up to 6cm long 8. *A. hansenii*
 + Leaves with petioles of 1.5-3cm, marginal bristles only occasionally present; flowers to 3.5cm long 9. *A. martinii*
11. Leaves with a striking silver indumentum; flowers up to 5cm long 10. *A. argentea*
 + Leaves glabrous; flowers to 3cm long 11. *A. tamacuensis*
12. Leaves pubescent on both surfaces; lip 1cm long 12. *A. microlophon*
 + Leaves glabrous or pubescent on lower surface only; lip 2.5-4.5cm long 13
13. Anther ecristate; bracteoles open to the base 14
 + Anther-crest well formed; bracteoles initially calyptate around unopened flower, usually pushed off at anthesis, occasionally splitting and remaining as the flower opens 15
14. Cincinni 2-flowered (flowers at the top of the inflorescence single); bracteole enfolding the bud 13. *A. latilabris*
 + Cincinni 3-4-flowered; bracteoles not enfolding the flower buds 14. *A. mutica*
15. Glabrous plants with striate leaf sheaths 15. *A. glabra*
 + Plants with strongly reticulate, pubescent leaf sheaths 15a. *A. glabra* var. *reticulata*

Alpinia galanga (L.) Sw., the common galangal, occurs as a village plant (and may have become wild in some areas). The rhizome is used for flavouring foods, and medicinally. The species is closest to *A. aquatica* but is easily distinguished by the longer bracteoles, to 1cm, much larger labellum which is shortly cleft centrally but not 4-lobed and in the red, rather than black fruit.

1. *Alpinia capitellata* Jack in Mal. Misc. 2, no. 7:4 (1820).

Type: Sumatra, near Benkoelen, *Jack* s.n. (n.v.).

Syn.: *A. grandiceps* Ridley in J. Str. Br. Roy. Asiat. Soc. 50:148 (1908).

Type: Sarawak, 1st Division, Kuching, xi 1907, *Hewitt* s.n. (K).

Languas capitellata (Jack) Merr. in Univ. Calif. Publ. Bot. 15:33 (1929).

Material seen:

SABAH: Sandakan, prov. Myburgh, Batu Lima, bracts red, lip with a yellowish white fringed margin, central portion yellow and red streaked, x-xii 1921, *Elmer* 20388 (UC, K); *ibidem*, ix-xi 1920, *Ramos* 1532 (K).

KALIMANTAN: Karangan R, N of Sangkulirang, sandstone, flowers dirty white with yellow tinge, inside brownish, 23 viii 1957, *Kostermans* 13531 (K).

A. capitellata also occurs in the Malay Peninsula. It belongs to the small sect. *Javana* K. Schum. and is characterized by the drooping inflorescence, which is enveloped by very large bracts (up to 10cm long), each of which subtends a cincinnus of several flowers. The bracteoles are papery in texture and tubular.

Ridley's claim that *A. grandiceps*, although closely allied to *A. capitellata*, is a much larger plant cannot be upheld.

2. *Alpinia sumatrana* (Miq.) K. Schum. in Bot. Jahrb., 27:291 (1899) & Pflanzenr. Zing. 358 (1904).

Type: Sumatra, Lampong, *Teysmann* 4436 (K).

Syn.: *Strobidia sumatrana* Miq., Fl. Ind. Bat. Suppl. 614 (1860).

Languas sumatrana (Miq.) Merr. in Univ. Calif. Publ. Bot. 15:35 (1929).

Material seen:

KALIMANTAN: without precise locality, *Korthals* s.n. (L).

A. sumatrana is very close to *A. conchigera* Griff. (1851) of the Malay Peninsula, differing in the smaller inflorescence and narrower, glabrous leaves. It was placed in sect. *Strobidia* by K. Schumann, a group characterized by the small, laxly borne cincinni, but otherwise not separable from the much larger sect. *Allughas*.

The labellum of *A. sumatrana* (and *A. conchigera*) bears a curious callus in the centre just in front of the lateral staminodes; there is no anther-crest. The cup-shaped bracteoles are persistent.

3. *Alpinia aquatica* (Retz.) Rosc. in Trans. Linn. Soc. Bot. 8:346 (1807); Burt & Smith in Notes RBG Edinb. 31:201 (1972). Fig. 5 A.

Type: probably Malaya 'Languas aquaticum s. sylvestre, habitat in uliginosis ad rivulos, inter frutices, minus frequens.' Koenig in Retz., Obs. Bot. 3:67 (1783). Specimen lost.

Syn.: *Heritiera aquatica* Retz., Obs. Bot. 6:18 (1791).

Hellenia melanocarpa Teysm. & Binn. in Nat. Tijdschr. Ned Dl. 24:328 (1862). Type: Cult. Bogor, presumably from Sumatra (n.v.).

A. rosella Ridley in J. Str. Br. Roy. As. Soc. 32:164 (1899). Type: Brunei, Kudat, 1897, *Hose* (K).

A. melanocarpa (Teysm. & Binn.) Ridley in J. Str. Br. Roy. As. Soc. 32:163 (1899); Val. in Ic. Bog. 2: t. 190 (1906).

A. fraseriana Oliv. in Hook. Ic. Pl. t. 1567 (1877). Syntypes: Sabah: *Fraser* s.n. (K); *Burbidge* s.n. (n.v.).

A. exostylis K. Schum., Pflanzenr. Zing. 314 (1904). Type: Kalimantan: *Korthals* s.n. (L).

A. cornu-cervi Ridley in J. Str. Br. Roy. As. Soc. 46:243 (1906). Type: Sarawak, s.l., *Hewitt* s.n. (K, SING).

?*A. rubella* Ridley in Bot. Jahrb. 44:35 (1910). Type: Kalimantan; between Kwaru and Suwaring, *Winkler* 3095 (n.v.).

A. quadriloba Ridley in Kew Bull. 1926:90 (1926). Type: Sumatra, Is. Sipora, *Boden-Kloss* 14724 (K).

Languas fraseriana (Oliv.) Merr. in Univ. Calif. Publ. Bot. 15:33 (1929).

L. cornu-cervi (Ridley) Merr., *op. cit.*, 34.

L. exostylis (K. Schum.) Merr., *op. cit.*, 34.

?*L. rubella* (Ridley) Merr., *op. cit.*, 35.

Selected Bornean specimens:

SABAH: Sandakan, Jalan Hujung Tanjong Sepilok F.R., primary forest, flower white, except for green staminodes, pink anther and red flush to labellum, 21 vi 1960, *Meijer* SAN 21217 (K); Marudi distr., Kudat,

Kitabu F.R., flower white, fruit green, 15 xii 1948, *Cuadra* 1190 (K).
 LABUAN IS., Lobuk Bay, ripe fruit black, 15 iii 1967, *Stone* 6679 (KLU).
 SARAWAK: 4th Division: Baram mouth, i 1895, *Hose* 62 (K); G. Mulu National Park, Sungei Tapin and S Tutoh, *Nielsen* 286 (AAU).
 KALIMANTAN: Sangkulirang subdiv., E Kutei, along Menubar R., 5m alt., loam soil with lime, flowers pink, 10 vi 1961, *Kostermans* 5122 (K).

Koenig's lengthy description leaves little doubt as to the correct epithet for this widely distributed species. *A. aquatica* is found throughout W Malaysia, Borneo and Sumatra where it occurs at low altitudes, often near the sea.

The species shows considerable variation in stature, from 0.5 to over 2m, and in leaf shape and size, but is well distinguished by the, usually remote, short bristles (sometimes reduced to bumps) of the leaf margin, the abundant small pink and white flowers in branched or unbranched inflorescences and the round, black fruits. The bracts are minute and quickly deciduous. The labellum, which is joined with the base of the filament into a c.2mm tube above the petals, is of variable shape (Fig. 4A, b, c) but is always deeply divided centrally, with equally deeply cleft lateral lobes, thus giving the structure a four-lobed appearance. Such a labellum is typical of sect. *Presleia* Val., a section well represented in the Philippines, and future studies will probably indicate the need for further synonymy.

A. exostylis differs in the shorter calyx and, according to Schumann, the long exerted style. The latter character is not apparent on the type material examined and in all other respects *A. exostylis* matches *A. aquatica* exactly.

In the recently published account of the Zingiberaceae in the *Flora Reipublicae Popularis Sinicae* (Tomus 16, 2, 1981) the name *A. aquatica* is applied to a plant known from riverside stations in Yunnan which is clearly not the same as the species discussed here.

4. *Alpinia ligulata* K. Schum. in Bot. Jahrb. 27:275 (1899) & Pflanzenr. Zing. 326 (1904); Burt & Smith in Notes RBG Edinb. 31:308 (1972). Fig. 4A.

Syntypes: Sarawak: 1st Division, Pininjau, ix 1865, *Beccari* 987 (FI); Mt Matang, i 1866, *Beccari* 1307 (FI).

Syn.: *A. reticosa* Ridley in J. Str. Br. Roy. As. Soc. 46:243 (1906). Type: Sarawak, 1st Division, Bau, *Ridley* s.n. (n.v.).

Languas ligulata (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:35 (1929).

Languas reticosa (Ridley) Merr. op. cit. 35.

Selected Bornean specimens:

SABAH: Beaufort distr., Kampung Bukau, swamp forest, 23 xi 1976, *Talib Bidab* SAN 84568 (K); Kalabakan distr., G. Rara F.R., 1600ft, primary forest, sandy soil, flowers reddish green, 15 iv 1972, *Chow* SAN 75698 (K); Elphinstone province, Tawao, x-xii 1921, *Elmer* 20506 (UC).

SARAWAK: 1st Div., Padawan distr., Kampong Braang Grumbing, common in lowland forest, 1-1.75m, flowers cream and red, base of lip with red lines on side lobes, fruits light brown, 12 v 1975, *Burt* 8116 (E).

R.M.S.

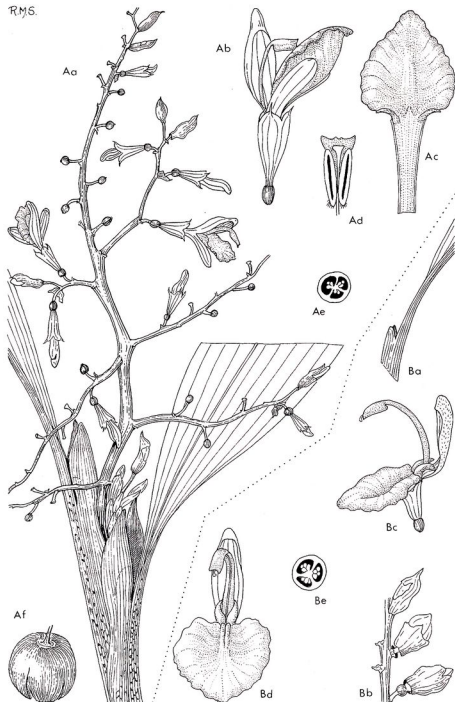


FIG. 4. A. *Alpina ligulata*. Aa, inflorescence and uppermost leaf sheaths $\times 1$; Ab, flower $\times 2$; Ac, labellum, lateral staminodes and corolla tube, dissected $\times 2$; Ad, anther and stigma $\times 4$; Ae, ovary in T.S. $\times 4$; Af, capsule $\times \frac{3}{2}$. (All from *Burt* 8116; Aa, Af from dried material, Ab-Ae from spirit material.) B. *Alpina nieuwenhuizii*. Ba, ligule $\times 1$; Bb, part of inflorescence branch showing bracts enclosing flower buds $\times 2$; Bc, flower $\times 2$; Bd, flower, from front; Be, ovary in T.S. $\times 4$ (all from *Burt* 12677; Ba, Bb from dried material, Bc-Be from spirit material).

4th Div., Miri, Bakam Rd, fruit round, pale green, 9 iv 1966, *Sibat ak Luang* S24850 (E, K, SAR); G. Mulu National Park, S Melinau, Tutoh, alluvial soil by river, sandstone derived but limestone influenced, primary forest, 5 x 1971, *Anderson* S31795 (E, K, SAR); *ibidem*, between S Melinau and S Terikan, petals greenish dotted and suffused red, lip frilled, side lobes lined red, bracteole enclosing bud, 15 vi 1975, *Burt* (E); *ibidem*, expedition base camp, 65m, secondary disturbed grassy area, lip with prominent transverse red stripes on creamy background, 1 iv 1978, *Argent & Coppins* 859 (E); *ibidem*, Hidden valley, alluvial forest on gravel, 450m, c.2m high, labellum with bright red veins, 5 iv 1978, *Nielsen* 928 (A.U.). 7th Division, Belega distr., Linau-Balui divide, flowers cream, lip with transverse red lines on wings and red in centre in lower part, crest erose, 6 ix 1978, *Burt* 11468 (E); *ibidem*, B. Lobang, S of Punan Lusong, basalt, common in forest, flowers pinkish overall, centre of lip yellow with transverse lines on each side, 25 viii 1978, *Burt* 11299 (E).
KALIMANTAN: Berau, Mt Njapa on Kelai R., 300m, flowers yellow with red stripes, 23 x 1963, *Kostermans* 21462 (K).

5. *Alpinia nieuwenhuizii* Val. in Bull. Inst. Bot. Buitenz. 20:86 (Oct. 1904) & in Ic. Bog. 2: t. 192 (1906). Fig. 4B.

Type: Borneo s.l., *Nieuwenhuis* (n.v.).

Syn.: *A. borneensis* Val. ex Gagnep. in Bull. Soc. Bot. Fr. 51:448 (Dec. 1904). Type: hort. Bogor, originally from Borneo (n.v.).

A. flava Ridley in J. Linn. Soc. Bot. 42:163 (1914). Type: Sabah, Gurulau spur above Kiau, common, ii 1910, *Gibbs* 4011 (BM).

Languas borneensis (Val.) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929).

Languas flava (Ridley) Merr. *op. cit.*

Selected Bornean specimens:

SABAH: G. Lumarku, near Sipitang, Mengalom to Milligan path, rain forest, c.1000m, on bank by stream, flowers pinkish with outer segments cream, lip with prominent transverse darker red lines on each half, 23 iii 1980, *Argent & Lamb* 1545 (E); Bili, 10 iii 1895, *Creagh* s.n. (K); east coast, without precise locality, 1895, *Creagh* s.n. (K); Kalabakan distr., G. Rara F.R., 1600ft, primary forest, sandy soil, flowers reddish pink, 15 iv 1972, *Chow* SAN 75699 (K).

SARAWAK: 2nd Division, Ulu S. Engkari, Lubok Antu, along river bank on sandy soil, flowers pink, 9 iii 1974, *Chai et al.* S.33575 (K); 3rd Division, Hose Mts, B. Mabong, tip whitish marked with transverse red bars on lower margin, petals greenish, 6 viii 1967, *Burt & Martin* B.4822 (E); 7th Division, S. Hose Mts, camp 1, S. Melinau, riverside, lip more or less deflexed, pellucid white centrally, lateral wings with transverse pink lines, 24 iii 1980, *Burt* 12677 (E).

A. ligulata and *A. nieuwenhuizii* are very closely allied, neither has, as yet, been recorded outside Borneo. Both species are characterized by the strongly paniculate inflorescence, and singly borne flowers. The bracts are similar in form to those of the Peninsular *A. oxymitra* K. Schum. (*Cenolophon oxymitrum* (K. Schum.) Holtt.) and form calyptrate structures around the buds. As the flower expands they are pushed off,

usually splitting as they do so. Sometimes the basal part remains, sometimes they are completely deciduous. There are no bracteoles.

A. ligulata is a frequent plant of the alluvial flood plains and more widely distributed than *A. nieuwenhuii*. It is easily recognized by the large, up to 6cm long, ligule and strongly reticulate leaf sheaths. The ligule is under 5mm long in *A. nieuwenhuii*, which is further distinguished by the obscurely reticulate leaf sheaths, usually much more floriferous inflorescence, non-apiculate calyx lobes, shortly pubescent petals and very fleshy central portion of the labellum. On close inspection this fleshy area consists of 2 flaps which are pressed tightly together in the undissected flower; such a condition is not to be found in *A. ligulata*. In Sabah at least, both species occur in the same localities and careful field work may indicate that some hybridization takes place.

The sectional position of *A. ligulata* and *A. nieuwenhuii* remains uncertain. The former was placed in his subgen. *Probolocalyx* by K. Schumann, a group which, at present, includes several not closely related species.

6. *Alpinia havilandii* K. Schum., Pflanzenr. Zing. 329 (1904). Fig. 5B.

Type: Sabah; Mt Kinabalu, *Haviland* 1233 (K).

Syn.: *Languas havilandii* (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929).

Selected Bornean specimens:

SABAH: Mt Kinabalu, Park HQ, S. Silau Silau, c.1600m, inflorescence lateral on leafy stems, breaking out between margins of sheath; flowers white, except for lip which is dark red within at base, running out as red stripes to the crimped edge, 11 v 1975, *Stone* 11414 (E); *ibidem*, boundary Rentis, 1463m, 22 i 1976, *Stevens et al.* 644 (E); *ibidem*, near HQ, edge of primary forest, dominated by *Quercus*, 6000m, lip red-pink veined, other parts of flower white, 20-27 ix 1977, *Gardner* 152 (E); *ibidem*, W route from Park HQ, B. Borong, in shade of tall ridge top rain forest, c. 1700m, fronds to 1m, flowering half way up stem, flower white with red patch on labellum, 2 iii 1980, *Argent et al.* 1431 (E); *ibidem*, oak forest, c.1600m, corolla white with pink-purple throat, inflorescence emerging c.45cm from ground level; fruit ripening golden brown, 24 iii 1982, *Sinclair* 178 (E).

A. havilandii is, as far as is known, restricted to the Mt Kinabalu area of Sabah. It is easily recognized by the apparently laterally borne inflorescence and dense golden orange pubescence of pedicels and ovary.

For comment on the sectional position of *A. havilandii* see no. 9 below.

7. *Alpinia ptychanthera* K. Schum. in Bot. Jahrb. 27:280 (1899) & in Pflanzenr. Zing. 330 (1904).

Type: Sarawak; 1st Division, Lundu, viii 1866, *Beccari* 2450 (F1).

Syn.: *Languas ptychanthera* (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:35 (1929).

The type material of *A. ptychanthera* is hopelessly inadequate. The flowers (none have been seen) are described as c.5.5cm long and the anther as ecristate. The species is certainly close to *A. havilandii*, but has

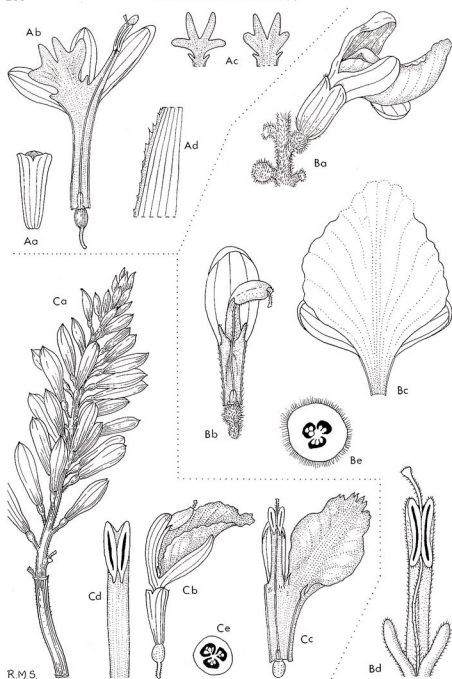


FIG. 5. A. *Alpinia aquatica*. Aa, calyx $\times 3$; Ab, flower, dissected $\times 3$; Ac, variation in labellum shape $\times 3$ (l, from dried material of SAN 32797 (K); r, from dried material of SAN 1890 (K)); Ad, leaf margin $\times 6$. (Aa, Ab from dried material of Keith 10005 (K); Ad from dried material of Stone 6679). B. *Alpinia havilandii*. Ba, part of inflorescence $\times 1$; Bb, Bc, flower, dissected $\times 1$; Bd, stamen, stigma, upper part of style and lateral staminodes $\times 2$; Be, ovary in T.S. $\times 3$. (from spirit material of Argent 1431). C. *Alpinia martinii*. Ca, young inflorescence $\times 1$; Cb, flower $\times 1$; Cc, flower, dissected $\times 1$; Cd, stamen $\times 2$; Ce, ovary in T.S. $\times 3$ (from dried material of Burt & Martin B4989).

elliptic, rather than lanceolate leaves, a much shorter ligule and a glabrous ovary.

8. *Alpinia hansenii* R. M. Smith in Bot. J. Linn. Soc. 85:70, fig. 17B (1982).

Type: Sarawak, 4th Division, G. Mulu National Park, S. Tutoh, opposite Long Tao, Ridge Camp top of lower montane forest, inflorescence about 20cm from apex, flowers white except for lip which is irregularly striped red and white, 950m, 28 ii 1978, *Hansen* 439 (C).

A. hansenii resembles *A. havilandii* in the lateral habit of the inflorescence and red and white flowers but is readily distinguished by the glabrous inflorescence and bristle-like marginal hair of the otherwise glabrous leaves.

***Alpinia* sp. (aff. *A. hansenii*)**

SARAWAK: 7th Division, Ulu Belaga, S. Semawat, c.250m, regrowing recently logged hill dipterocarp forest, 2m high, inflorescence 50cm from apex, fruit, immature, green tinged with purple, 21 x 1981, *Hansen* 762 (C).

This fruiting collections differs from *A. hansenii* in the pubescent leaf undersurfaces and tomentose rhachis. The leaf margins bear remote 'bumps' which are only sometimes prolonged into bristles. The spherical capsules are at least 2.5cm in diameter.

9. *Alpinia martinii* R. M. Smith, *species nova* *A. hansenii* floribus rubris et albis in axillis bractearum solitariis similis sed foliis petiolatis, axi inflorescentiae pubescente, floribus minoribus differt. Fig. 5C.

Herba epiphytica. Folia petiolis 1.5-3cm; lamina 16-45 x 3-5cm, lanceolata, setis paucis marginalibus (non semper adsentibus) exceptis glabra; ligula 2-5mm, coriacea, glabra, breviter biloba; vaginae plus minusve glabrae. *Inflorescentia* in fronda foliata terminalis, 9-12cm, breviter pubescens, ut videtur subhorizontalis; nec bractee nec bracteolae visae, sed cicatricibus bractearum superne adsentibus. *Flores* rubri et albi, solitarii; pedicelli 3-6mm; calyx 1-1.5cm, leviter lobata, lobis rotundatis, basin versus minute pubescens; corollae tubus calycem aequans, ore intus pubescens; lobi c.1.5cm longi, apicibus rotundati; labellum ad 2 x 1.5cm, rubrum, albo-lineatum, trapeziforme, fimbriatum, obscure trilobum; staminodia lateralia c. 3-4mm, subulata, breviter pubescentia; stamen 1.5-1.8cm, filamento 1-1.2cm; anthera 6-8mm, thecis calcaribus brevibus basi instructis, connectivo-emarginato; stigma cupiforme, ciliato-marginatum; stylus superne pubescens; glandulae epigynae 5mm, inter se lateraliter connata; ovarium 3-4mm brevissime et parce pubescens, trilobulare, placentis axilis. Fructus ignotus.

Type: Sarawak, 3rd Division, Hose Mts, epiphyte, above Ulu Melinau falls, flowers red and white, petals red tipped, labellum red, white lined, somewhat fimbriate, 20 viii 1967, *Burt & Martin* B4989 (holo. E).

Other material seen:

SARAWAK: 4th Division, Dulit Range, c.1200-1300m, epiphyte on tall tree among moss, tube of flower dull orange externally, lower petals white

with crimson tip, labellum crimson, paler near apex, 7 x 1932, *Richards* 2170 (K); 7th Division, S Hose Mts, W of Sanpandai, c.1100m, mossy tree roots overhanging cliff, petals tipped dark red, lip white ground with dark red veins, wing almost solid red except for white margin, 1 iv 1980, *Burt* 12758 (E).

This species is named after Mr Adam Martin, Scottish horticultural advisor, who accompanied Mr B. L. Burt on his 1967 expedition to Sarawak.

A. martinii may be distinguished from the similarly red and white flowered *A. havilandii* and *A. hansenii* by the petiolate leaves and smaller flowers; the inflorescence is not pushed out laterally and the leaves are quite glabrous save for occasional bristle-like marginal hairs.

A. havilandii, *ptychanthera*, *hansenii* and *martinii* form a closely related group characterized by the singly borne ebracteolate flowers; no bracts have been observed, but scars may be seen on most of the collections. Their sectional position is probably *Cenolophon*, although the usually massive ecristate anther, from which the style is exerted, suggests an affinity with sect. *Catimbium*. There, however, bracteoles are always present and the flowers are generally borne in 2-4 flowered cincinnii.

10. *Alpinia argentea* (Burt & Smith) R. M. Smith in Bot. J. Linn. Soc. 83:69 (1982).

Type: Sarawak, 4th Division, Bakelalan to Mt Murud, above S. Komat, flowers greenish, lip lined red and staminodes red, 23 ix 1967, *Burt* & *Martin* B5166 (holo. E).

Syn.: *Cenolophon argenteum* Burt & Smith in Notes RBG Edinb. 31:310, fig. 12 (1972).

Other material seen:

SARAWAK: 3rd Division, near Long Kapa, Mt Dulit, 300m, old secondary forest, perianth orange red, rest of flower orange, 2 ix 1932, *Richards* 1591 (K). 4th Division: G. Mulu National Park, G. Mulu, c.2000m, flowers cream, lip red lined, fimbriate, staminodes blood red, stigma white, leaves silvery below, sheaths silver mottled, 17 v 1963, *Burt* & *Woods* B2128 (E); S flank of G. Benarat, flowers pale apricot with two blood red patches at base of lateral lobes, upper edges of lip sometimes marked blood red, 24 vi 1962, *Burt* & *Woods* B2268 (E); N end of G. Benarat, 200-400m, lip yellow with red patch at base of frilly margin, 22 vi 1975, *Burt* 8353 (E).

A. argentea is characterized by the silvery indumentum of leaves and sheaths. A collection from the Mulu National Park, *Hansen* 394 (C), has a much less dense indumentum and long petiolate leaves. More observations are needed on vegetative variation within the species.

11. *Alpinia tamacuensis* R. M. Smith in Bot. J. Linn. Soc. 83:71, fig. 17C (1982).

Type: Sarawak, 4th Division, G. Mulu National Park, near camp on NW ridge of G. Tamacu, open position on summit, c.1200m, 6 v 1978, *Argent* & *Coppins* 1171 (holo. E).

Other material seen:

SARAWAK: *ibidem*, 7 v 1978, *Argent* & *Coppins* 1180 (E); 4th Division,

ROYAL BOTANIC GARDEN, EDINBURGH

NOTES FROM THE ROYAL BOTANIC GARDEN,
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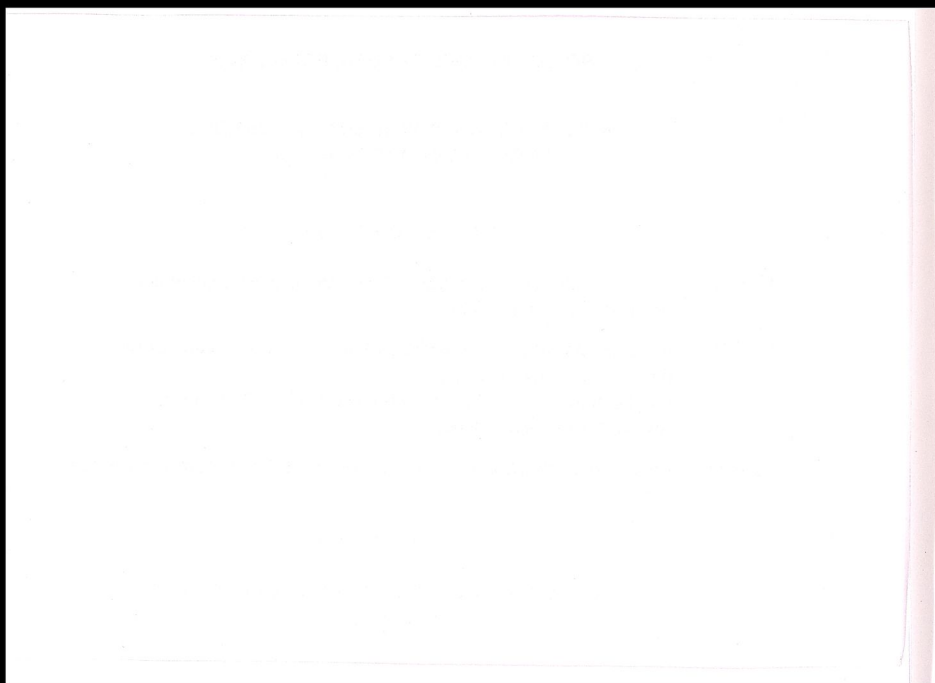
CORRECTIONS

- Page 284: line 11 should read – Syntypes: Cochinchina, various collections, Borneo, *Chaper* s.n. (omnes n.v.)
- Page 307: line 5 should read – cucullatam prolongato; ovarium 5mm, dense pubescens. *Fructus* ignotus.
line 12 should read – 13. *Amomum paucifolium* R.M. Smith, species nova *A. laxisquamosae*
- Page 353: *Cymbidium cuperifolium* Lindl. should read *Cymbidium cyperifolium* Lindl.

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March 1985



Kelabit highland, Baram Distr., summit of Apo Dari, 1550m, 17 xi 1974, Chai S35919 (K); 5th Division, Long Semadoh to Bakelalan and G. Murud, on cliff face in moss, fruit only, 1967, *Burt & Martin* B5398 (E).

A. tamacuensis is readily distinguished from *A. argentea* by its much smaller stature and narrow, glabrous leaves. Both species belong to sect. *Cenolophon* and are known only from Sarawak.

12. *Alpinia microlophon* Ridley in J. Str. Br. Roy. As. Soc. 54:58 (1910).

Type: Sarawak, 1st Division, Upper Sarawak R., white, red streaks and blotches, ix 1908, *Brookes* s.n. (K).

Syn.: *Languas microlophon* (Ridley) Merr. in Univ. Calif. Publ. Bot. 15:35 (1929).

After failing to locate the type of *A. microlophon* in the named collections at K or BM, a specimen from which the collector's name is lacking came to light amongst the undetermined *Alpinia* at Kew. As the information recorded on the label is exactly as above, there is no doubt that this sheet is C. J. Brookes, specimen.

Ridley placed *A. microlophon* in sect. *Cenolophon* but the flowers arise in 2-3-flowered cincinni and are subtended by conspicuous papery bracteoles. The plant is almost entirely pubescent throughout and, in general facies, is remarkably similar to *A. pahangensis* Ridley of the Malay Peninsula. It differs, however, in the glabrous reticulate leaf sheath, non-tubular bracteole, more densely pubescent calyx and in the small (and entire?) labellum.

A collection from Mt Matang; damp shady hollow, just below 5th peak, 2500ft, 15 v 1961, *Collenette* 694 (K), is perhaps the same species, but the material is insufficient as no mature flowers are to be found on the unexpanded inflorescence.

13. *Alpinia latilabris* Ridley in J. Str. Br. Roy. As. Soc. 32:268 (1899).

Type: Hort. Calcutta, perhaps originally from Pahang (n.v.).

Syn.: *A. hookeriana* Val. in Bull. Inst. Bot. Buitenz. 20:81 (1904) & in Ic. Bog. 2 t. 189 (1906). Type: hort. Bogor, originally from Borneo (n.v.).

A. mutica sensu Hook. f. in Bot. Mag. t. 6908 (1886)—non *A. mutica* Roxb.

A. sericea Ridley in J. Linn. Soc. Bot. 24:163 (1914). Type: Sabah: Mt Kinabalu, Korikut, 2500m, ii 1910, *Gibbs* 3025 (BM).

Languas hookeriana (Val.) Merr. in Univ. Calif. Publ. Bot. 15:34 (1929).

L. sericea (Ridley) Merr. op. cit., 35.

Other Bornean material seen:

SABAH: Sandakan, Elopura, Lun Manggis, 20m, on flat land, flower white yellow with red stripes inside the corolla, fruit round, sour, edible, 21 v 1950, *Agama & Kadir* NBFDA 2816 (K); Ganduman FR, Tambisan, 50m, SW of Kampung Tegupi on flat land, 15 ix 1975, *Saikeh* SAN 82298 (K); Mt Kinabalu, 18 iv 1980, *Lamb* s.n. (E).

Despite its higher altitude station, *A. sericea* cannot be separated from the low level *A. latilabris*. This handsome species, which belongs to sect.

Catimbium is easily recognized by the large, up to 20cm long, inflorescence. The large pink and white flowers, which are borne in pairs or, towards the top of the rachis, singly, are protected at first by broad bracteoles. The labellum is rich yellow, densely marked with crimson spots and blotches. The globose orange fruit may be up to 2.5cm in diameter.

14. *Alpinia mutica* Roxb. in *Asiat. Res.* 11:354 (1810); Val. in *Ic. Bog.* 2:299 (1906); Burt & Smith in *Notes RBG Edinb.* 31:308 (1972).

Type: Hort. Calcutta, originally from Penang (n.v.).

Syn.: *A. laxiflora* Gagnep. in *Bull. Soc. Bot. Fr.* 48:LXXXVIII (1901).

Syntypes: Cochinchina, various collections; Borneo, *Chapter* s.n. (omnes n.v.).

A. mutica var. *laxiflora* (Gagnep.) Gagnep. in *Fl. Gen. Ind. Ch.* 6:98 (1908).

A. korthalsii K. Schum., *Pflanzenr. Zing.* 327 (1904). Syntypes: Kalimantan, Pontianak, S. Upanang, v 1867, *Beccari* 3557 (FI); Banjarmasin, generally distributed, flowers white, labellum veined reddish purple, stamen yellow, 1857-8, *Motely* 234 (K); s.l. *Korthals* (n.v.).

Languas korthalsii (K. Schum.) Merr. in *Univ. Calif. Publ. Bot.* 15:34 (1929).

L. laxiflora (Gagnep.) Merr. op. cit. 34.

L. mutica (Roxb.) Merr. op. cit., 35.

Other material seen:

KALIMANTAN: W Koetai, near B. Phoeoes, sandy soil, stone bank, 80m, 15 ix 1925, *Endert* 4955 (K).

A. mutica also belongs to sect. *Catimbium*, and differs from *A. latilabris* in the quickly deciduous bracteoles, which are narrower and do not enfold the flower buds, and in the 3-4-flowered cincinni.

***Alpinia* sp.** (aff. *A. mutica*)

SARAWAK: 1st Division, Puak, river bank, 16 ix 1908, *Hewitt* 1335 (K); 7th Division, Belaga, Ulu Sebako, silty clay river bank, secondary vegetation, outer segments cream, labellum rich yellow outside, deep crimson within but for yellow margin, 9 iv 1963, *Ashton* S17713 (K).

KALIMANTAN: camp Tikah, Longagun, disturbed primary forest, 50m, fruit green, turning red, 28 vi 1975, *Wiriddinata* 670 (K).

It is unfortunate that no flowers suitable for dissection are to be found on the above collections. The taxon may be no more than a variety of *A. mutica*, with which it agrees in the number of flowers per cincinni and the narrow bracteoles. It is, however, a much smaller plant with consistently linear leaves which rarely exceed 2cm in width.

15. *Alpinia glabra* Ridley in *J. Str. Br. Roy. As. Soc.* 32:168 (June 1899); Burt & Smith in *Notes RBG Edinb.* 31:307 (1972). Fig. 6.

Type: Sarawak, 1st Division, Mt Santubong, *Haviland* (presumably H.444, K).

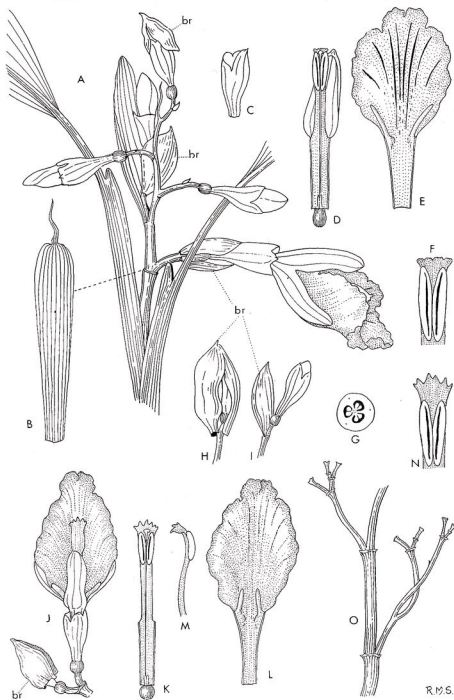


FIG. 6. *Alpinia glabra*. A, inflorescence $\times 1$, B, bract $\times 1$; C, calyx $\times 1$; D, E, flower, dissected $\times 1$; F, anther $\times 2$; G, ovary in T.S. $\times 3$ (from living material of *Burti & Martin* B4876); H, cincinnus protected by first bracteole $\times 1$; I, cincinnus, first bracteole removed to show second bracteole and first flower bud $\times 1$ (from dried material of *Kiew* 389); J, cincinnus, first bracteole fallen $\times 1$; K, L, flower dissected $\times 1$; M, stamen, lateral view $\times 1$; N, anther $\times 2$ (from spirit material of *Burti* 8326); O, lower part of old inflorescence, showing short lateral branch $\times 1$ (from dried material of *Burti & Martin* B5221); br = bracteole.

Syn.: *A. flexistamen* K. Schum. in Bot. Jahrb. 27:279 (Sept. 1899) & Pflanzenr. Zing. 328 (1904). Type: Sarawak, 1st Division, Mt Matang, 1865/68, *Beccari* 1491 (FI).

A. angustifolia K. Schum. in Bot. Jahrb. 27:279, t. 2, f. j (Sept. 1899) & Pflanzenr. Zing. 328 (1904). Type: Mt Matang, *Beccari* 3602 (FI).

Languas angustifolia (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:33 (1929).

L. flexistamen (K. Schum.) Merr., op. cit., 34.

L. glabra (Ridley) Merr., op. cit., 34.

A. glabra, which was placed in subgen. *Probolocalyx* by Schumann, is widespread throughout Sarawak and also occurs in Brunei and Sabah. Usually a low altitude plant often found by stream sides, it shows considerable variation in leaf size, petiole length and inflorescence colour. However, all the specimens seen have the following characters in common:

1. Glabrous plants with distinctly (often very long) petiolate leaves.
2. A bilobed ligule.
3. A lax inflorescence, which may produce short lateral branches towards the base but is never strongly paniculate; cincinni of 2-3 flowers occasionally appearing single flowered by the abortion of the later buds.
4. Quickly deciduous bracts (few seen); large papery bracteoles which are calyptrate at first and, as a rule, pushed off before anthesis.
5. A well-formed anther-crest.
6. A spherical capsule, orange, as far as is known.

Colour variation in A. glabra

The material cited below is restricted to collections which supply full details of inflorescence colour. The plants divide into two main groups:

Group A. Plants with white bracteoles, calyces, petals and (usually) pedicels; labellum generally red with dark lines, rarely with some yellow. The type collection of *A. glabra* probably belongs here.

SARAWAK: 1st Division, Bidi, vii 1893, *Ridley* 11810 (K)—for colour notes see *Ridley* in *Journ. Str. Br. Roy. As. Soc.* 46:244 (1906). 4th Division, G. Mulu National Park, ascent from river to moss forest, 14 iv 1962, *Burt & Woods* B2089 (E); *ibidem*, c.350ft, S. Terikan to S. Medalam, 20 vi 1975, *Burt* 8326 (E); *ibidem*, around camp 1, 150m, lowland rain-forest, 4 iv 1978, *Argent et al.* 900 (E); *ibidem*, base of Panti ridge, quite common, 23 vi 1978, *Kiew* 389 (E); Lambir National Park, c.1100ft, ridge SW of B. Lambir, 28 ix 1978, *Burt* 11630 (E); Bakelalan to Mt Murud, near camp 3, 26 ix 1967, *Burt & Martin* B5221 (E).

SABAH: G. Lumarku, near Sipitang, 600m, 20 iii 1980, *Argent & Lamb* 1491 (E); *ibidem*, western path to summit, submontane rain forest, *Argent & Lamb* 1535 (E); Sandakan, Meliau R., 2 miles from Kuala near Kiabau, 50m, primary dipterocarp forest, 12 v 1965, *Meijer & Kodoh* SAN 50030 (K).

Argent & Lamb 1535 deviates in having a bilobed rather than irregularly toothed anther-crest and a yellow margin to the labellum.

Group B. Pedicels, bracteoles, calyces and petals dark red (rarely pink); labellum orange yellow with red lines or pink with darker lines.

SARAWAK: 3rd Division: Hose Mts, above Ulu Melinau falls, 20 viii 1967, *Burt & Martin* B5008 (E); *ibidem*, below B. Nibong, 9 viii 1967, *Burt & Martin* B4876, cult, RBGE C8136 (E). 4th/5th Division, Bakelalan to Mt Murud, stream below camp 3, 29 ix 1967, *Burt & Martin* B5300 (E). 7th Division, S. Hose Mts, W of B. Sanpandai, camp 4, wet forest slopes, 1 iv 1980, *Burt* 12757 (E).

Burt & Martin B4876, although differing from the other material seen in the much smaller anther crest, is illustrated in Fig. 6. This collection flowered in cultivation at Edinburgh several years ago, thus providing an opportunity for study of the bracts and bracteoles. Each cincinnus is at first protected by a large membranous bract which very soon falls; the bracteoles may be pushed off in their entirety as the buds expand, remaining more or less calyprate, or become split and enfold the calyx as the flowers open. As they are very easily dislodged, bracteoles are rarely seen in herbarium material, other than on young inflorescences.

The following exsiccata belong to *A. glabra* but due to lack of colour notes or because they were collected in fruit cannot be placed in groups A or B:

SARAWAK: *Ridley* 11809; *Mjoberg* 245; *Moulton* 6696; *Clemens* 22156; *Chai* S39481; S19343; *Sibat ak Luang* S22527 (K); *Burt* 11309; *Kiew* 373; *Argent & Coppins* 1063 (E).

BRUNEI: *Ashton* 140, 187, 361 (K).

17. *Alpinia glabra* var. *reticulata* R. M. Smith, var. nov. a var. *glabra* vaginis foliorum prominenter reticulatis et pubescentibus differt.

Type: Sarawak, 4th Division, Bukit Mersing, Tau Range, 1700ft, 1 vi 1956, *Purseglove* 5277 (holo. K).

SARAWAK: 1st Division, Mt Matang, red, vii 1893, *Ridley* 11808 (K); 4th Division: S. Mayeng, Tau Range, 400ft, peduncle and flowers deep red, 29 v 1956, *Purseglove* 5176 (K); B. Mersing, Anap, flowers red, 200m, basalt derived soil by stream, 16 x 1964, *Sibat ak Luang* S22517 (K). 4th/5th Division, Bakelalan to Mt Murud, stream below camp 3, red pedicel, white bracteole and calyx, more or less translucent, faintly yellow petals, lip orange yellow lined red, 29 ix 1965, *Burt & Martin* B5289 (E). 3rd Division, Ulu Sungei Sedampa, extreme headwaters of Batang Balleh, Kapit distr., primary forest, small ravine, sandstone, 1500ft, fruit globular, dark purple, 2 vii 1969, *Ilias bin Paie* S28362 (E). 7th Division, Belaga distr., S. Dema earth stream bank, inflorescence, pedicel calyx and corolla red, anther crest irregularly toothed, fruit round dull orange brown, 30 viii 1978, *Burt* 11363 (E).

A. glabra var. *reticulata* shows inflorescence colour variation similar to that found in the species. The strongly reticulate leaf sheaths are very distinctive, although their degree of pubescence varies considerably, and the main veins of the broadly lanceolate to elliptic leaves are conspicuously raised.

A collection from Mt Dulit, *Richards* 2492 (K), has similar reticulated leaf sheaths but differs in the narrower leaves, and smaller and densely pubescent flowers. No bracteoles are to be seen, but the inflorescence, although rather depauperate, is of similar structure to that of *A. glabra*.

Excluded species:

A. brachypoda K. Schum. = **Plagiostachys strobilifera** (Bak.) Ridley

A. crocydocalyx K. Schum. = **Plagiostachys crocydocalyx** (K. Schum.)
Burt & Smith

A. cylindrostachys K. Schum. = **Amomum coriaceum** R. M. Smith

A. longilora Ridley = **Burbridgea longilora** (Ridley) R. M. Smith

A. polycarpa K. Schum. = **Amomum polycarpum** (K. Schum.) R. M. Smith

TRIBE ALPINEAE

B. Inflorescence borne separately from the leaf shoot

KEY TO THE GENERA

1. Inflorescence compact; bracts imbricate 2
- + Inflorescence lax; bracts never imbricate 6
2. Inflorescence enclosed by an involucre of rigid sterile bracts, fusiform or occasionally cyathiform at the apex; 2-3 flowers opening at a time and only their tips visible 1. *Hornstedtia*
- + Inflorescence with or without sterile bracts, if present then not markedly rigid, usually cone shaped or flat topped; often with many flowers open at a time 3
3. Sterile bracts absent; base of lip and filament not joined to form a tube above the insertion of the petals 2. *Amomum*
- + Sterile bracts present, sometimes showy and brightly coloured; base of lip joined with the filament to form a distinct tube above the insertion of the petals 4
4. Inflorescence held above ground on an erect peduncle; sterile bracts showy 3. *Nicolaia*
- + Inflorescence arising at ground level, often partially subterranean 5
5. Labellum with a much elongated midlobe 4. *Achasma*
- + Labellum not elongated 5. *Geanthus*
6. Inflorescence prostrate, sometimes almost entirely subterranean, usually much elongated 7
- + Inflorescence erect or decurved 8
7. Leaf shoots few bladed; bracteoles open to the base; anther-crest prominent 6. *Elettariopsis*
- + Leaf-shoots frond-like; bracteoles tubular; anther-crest absent or minute 7. *Elettaria*
8. Labellum divided to the base into two narrow lobes; filament dentate 8. *Geocharis*
- + Labellum entire or shallowly 3-lobed; filament not dentate 9. *Geostachys*

1. *Hornstedtia* Retz. Obs. Bot. 6:18 (1791).

Hornstedtia is a well defined genus characterized by the rigid involucre of sterile bracts which encloses the entire inflorescence save for the uppermost part of the open flowers. The inflorescence which is often held above ground on stilt roots, may be cyathiform or, more commonly, fusiform. In all but one known species each fertile bract subtends a single flower and the bracteoles, when present, are open to the base; the exception is the Malayan *H. leonurus* which has two flowers per bract and tubular bracteoles. The corolla tube is very long and slender throughout the genus and, unlike *Achasma*, *Geanthus* and *Nicolaia* which are also distinguished by the presence of sterile bracts, no tube is formed by the base of the labellum and filament above the insertion of the petals.

Valeton (*Bull. Jard. Bot. Buitenz. sér. 3, 3:150-179, 1921*) subdivided *Hornstedtia* into three subgenera, *Hornstedtia* (*Scyphifera* Val.), *Elettariostemon* and *Rosianthus*. The Bornean plants all fall within the first two groups, *Rosianthus* comprises a single Indonesian species, *H. rubra*.

Hornstedtia's main centre of distribution is to be found in Malaysia and Indonesia, but the genus extends to New Guinea, the Solomons and northern Queensland.

KEY TO THE SUBGENERA AND SPECIES

1. Anther with a distinct filament; thecae fertile in the upper half only; connective prolonged into a rounded crest; stigma more or less cup-shaped with an apical opening (subgen. *Hornstedtia*)..... 2
 - + Anther sessile; thecae fertile throughout their length; connective emarginate with a small lobe at the apex of each theca; stigma rounded with a dorsal opening (subgen. *Elettariostemon*) 6
2. Flower resembling the beak of a duckbilled platypus; labellum lacking side lobes, free from the lateral petals; filament broader than the anther 1. *H. tomentosa*
 - + Flower not as above; labellum with prominent side lobes; lateral petals adnate to the centre of the labellum; filament not broader than the anther 3
3. Sterile bracts velvety tomentose sometimes with a few obscure reticulations; calyx much more than half the length of and sometimes as long as the corolla tube 2. *H. incana*
 - + Sterile bracts prominently reticulate-areolate; calyx c. $\frac{1}{2}$ the length of the corolla tube 4
4. Rhizome not supported on stilt roots; indumentum of sterile bracts soft to the touch 3. *H. scyphifera*
 - + Rhizome supported on stilt roots; indumentum of the sterile bracts scabrid to the touch..... 5
5. Inflorescence cyathiform; sterile bracts very strongly reticulate with pronounced longitudinal ribs, cross bars glabrous towards the apex 4. *H. reticulata*
 - + Inflorescence fusiform; sterile bracts with much less pronounced longitudinal ribs; cross bars pubescent throughout 5 *H. piniga* var. *borneense*

6. Peduncle up to 40cm long; sterile bracts reticulate 6. *H. havilandii*
 + Peduncle 2-3cm long; sterile bracts without reticulations..... 7
 7. Sterile bracts glabrous; margin of ligule long-ciliate..... 7. *H. affinis*
 + Sterile bracts with a silky, felt-like indumentum; ligule not ciliate on
 margins..... 8. *H. minor*

1. *Hornstedtia tomentosa* (Bl.) Bakh. f. in *Blumea* 12:65 (1963); Burt & Smith in *Notes RBG Edinb.* 31:214, fig. 13 (1972).

Type: Java; Bantam, *Kuhl & van Hassel* (n.v.).

Syn.: *Donacodes tomentosus* Bl., *Enum. P. Jav.* 55 (1827).

D. villosus Teysm. & Binn. *Cat.* (1886); *Kruidk. Arch.* 3, t. 10, f. 15-16 (1855).

Hornstedtia villosa (Taysm. & Binn.) Val. in *Ic. Bog.* 2: t. 170 (1905)
 & in *Bull. Jard. Bot. Buitenz. sér.* 3, 3:166 (1921).

Material seen:

SARAWAK: 1st Div., Mt Matang, subterranean rhizome, yellow red petals, labellum ridged, yellow within, 7 ix 1967, *Burt & Martin* B5151 (E); 3rd Div., Hose Mts, cliffs below B. Mabong, red and yellow flowers, very stiff labellum, 5 vii 1967, *Burt & Martin* B4790 (E).

H. tomentosa is a very distinct species. The flowers resemble the beak of a duckbilled platypus; Valeton remarks that by pressing either side it opens like a snake's mouth. The Javan plant may occur with short stilt roots; this character has not been observed in the Bornean material. The broad filament, stiff oblong labellum and unexpanded stigma are unlike any other *Hornstedtia* and the 2.5-3cm ligule quite the longest of the genus.

2. *H. incana* R. M. Smith, *species nova* ob reticulum bractearum steriliium absens et calycem longum *H. reticosae* Val. similis sed rhizomate radicibus suffulcientibus praedito, vagnis foliorum lenius reticulatis, colore bractearum steriliium differt. Fig. 7B.

Fronda foliosa 2-2.5m alta. *Folia* subsessilia; lamina ad 40 x 6-7cm, lanceolata, glabra, acuta; ligula 5-7mm, integra, coriacea, pubescens; vaginae obscure reticulatae, marginibus dense pubescentibus. *Inflorescentia* e rhizomate acria producta, sessilis vel breviter pedunculata, 8-10cm longa, fusiformis; bractee steriles ad 6 x 3cm, anguste ovatae, apice rotundato mucrone parvo instructo, indumento griseo-velutino indutae, ad margines glabrescentes; bractee fertiles griseae, c.8 x 2cm, glabrae; bracteolae 4-4.5cm carinatae, *Flores* rubri; calyx 4.5-6cm, tridentatus; corolla tubo 6-7cm; lobi 2.5cm, rotundati; labellum 2.5-3cm longum, dimidio inferiori 2cm latum superne c.7mm latum, lobis antheram involventibus intus breviter pubescentibus; staminodia lateralia ad tumores parvos redacta vel absentia; filamentum 6-7mm, marginibus carnosum, breviter pubescens; anthera c.6mm longa, carnosa, pubescens, dimidio superiore tantum dehiscens, connectivo in cristam rotundatam 4mm longam prolongato; stigma cupiforme, ore ciliatum; stylus parte superiore quarta parte pubescens; glandulae epigynae c.1.2mm, plerumque inter se connatae; ovarium 1cm, glabrum, triloculare vel imperfecte triloculare, ovalis axilibus. Capsula 3cm longa, ampulliformis, laevis.

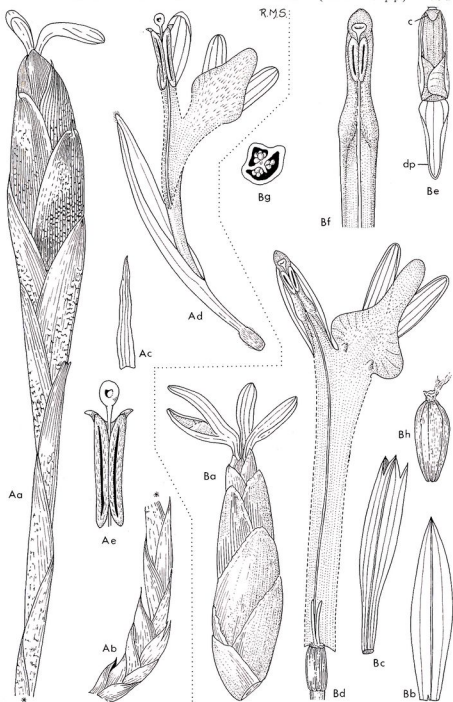


FIG. 7. A. *Hornstedtia havilandii*. Aa, Ab, inflorescence and peduncle $\times \frac{2}{3}$; Ac, bracteole $\times 1$; Ad, corolla, dissected $\times 1$; Ae, stamen and stigma $\times 2$. (Aa, Ab from dried material of Beccari 1148; Ac–Ae from spirit material of S29404). B. *Hornstedtia incana*. Ba, inflorescence $\times \frac{2}{3}$; Bb, bracteole $\times 1$; Bc, calyx $\times 1$; Bd, flower, dissected $\times 1$; Be, upper part of corolla, dorsal petal (dp) folded back to show natural position of labellum with side lobes curving round stamen and reflexed anther-crest (c) $\times 1$; Bf, stamen, with stigma and upper part of style $\times 2$; Bg, ovary in T.S. $\times 2$; Bh, young capsule $\times \frac{2}{3}$. (Ba, Bd, Bf, Bg from spirit material of Burt & Martin B5402; Bb, Bc, Be, Bh from spirit material of Hansen 512).

Type: Sarawak, 4th Division, G. Mulu National Park, camp 4, 1760m, moss forest in upper montane rain forest, open scrubby area on steep slope where trees had fallen, 80cm long rhizome lifted above ground by stilt roots, bracts whitish grey with a brownish margin or green towards the apex, flowers red, 19 iii 1978, *Hansen* 512 (holo. C).

SARAWAK: 4/5th Division boundary, Bakelalan to Mt Murud, cliffs near camp iv, aerial rhizome, bracts grey on back except at margins, flowers red, 5 x 1967, *Burt & Martin* B5402 (E).

SABAH: Mesilau R., Mt Kinabalu, c.2000m, rhizome on stilt roots, bracts pale grey green, flowers red, 25 ii 1980, *Argent & Lamb* 1366 (E).

H. incana is the only known Bornean representative of sect. *Hornstedtia* which lacks prominent reticulate patterning on the sterile bracts. The indumentum of the bracts of the type specimen is velvety and unbroken; that of B5402 shows some pitting but no cross bars. This indumentum type is similar to that of the Sumatran *H. reticosa* Val., which also belongs to sect. *Hornstedtia*, but differs in the absence of stilt roots, much more strongly reticulate leaf sheaths and red ground colour of the sterile bracts.

3. *Hornstedtia scyphifera* (Koenig) Steud., Nomencl. 2: (1840); K. Schum., Pflanzenr. Zing. 195: (1904).

Type: Malaya, *Koenig*, specimen lost.

Syn: *Amomum scyphiferum* Koenig in Retz. Obs. Bot. 3:68 (1783).

The following material probably belongs here:

SARAWAK: 1st Division, G. Berumpet, Poi Range, c.1100m, flowers more or less scarlet; centre of lip blackish purple, 13 viii 1962, *Burt & Woods* B2824 (E); 3rd Division, Hose Mts, hill E of overhang at B. Semako, flower red, the back of the anther, which lies along the labellum, much darker than the rest, 22 viii 1967, *Burt & Martin* B5057 (E); 7th Division, Belaga Distr., Linau-Balui Divide, c.800m, flower red, upper side of stamen much darker, 5 ix 1978, *Burt* 11451 (E).

SABAH: Mountain trail, Kinabalu National Park, near HQ, flowers dark red, 20-27 ix 1977, *Gardner* 154 (E).

The above agree reasonably well with the peninsular plant. *H. scyphifera* is characterized by the lack of stilt roots, open mouthed inflorescence, short calyx and the ovary which is glabrous except for a ring of hair at the apex. The indumentum of the reticulate-areolate sterile bracts is soft and velvety.

4. *Hornstedtia reticulata* (K. Schum.) K. Schum., Pflanzenr. Zing. 193 (1904).

Type: Sarawak, 1st Div., Kuching, 1865, *Beccari* 32 (K).

Syn.: *Amomum reticulatum* K. Schum. in Bot. Jahrb. 27:303 (1899).

Material seen:

SARAWAK: 1st Division: Penkulu Ampat, vi, *Haviland* s.n. (K-syntype of *H. havilandii* K. Schum.); Semengoh Forest Reserve, rhizome on stilt roots, red flowers, 14 ix 1967, *Burt & Martin* B5158 (E); *ibidem*, 24 vii 1967, *Burt & Martin* B4717 (E). 4th Division, Lambir National Park, short stilt roots, bracts red, spreading at the top, flower wholly red, 21 ix

1978, *Burtt* 11560 (E). 7th Division, Kapit Distr., S. Melinau, 200ft, Rumah Ungka, in old rubber plantation, bracts outturned at the top, flowers three at a time, pale red, 19 iii 1980, *Burtt* 12653 (E).

H. reticulata is very distinctive. The cyathiform inflorescence is borne on stilt roots and the sterile bracts, which are the most strongly reticulated of all Bornean *Hornstedtia* are scabrid to the touch. There is some variation in petiole length; the leaf of the type collection is sessile, the remainder vary from subsessile in the Penkulu Ampat specimen to long (up to 4cm) petiolate in the plant from Lambir. As none of the cited material includes a range of leaves it is unwise to lay much importance on this variation.

For comment on the inclusion here of the syntype of *H. havilandii* see no. 6 below.

5. *Hornstedtia pininga* (Bl.) Val. in Bull. Jard. Bot. Buitenz. 20:57 (1904) & in Ic. Bog. 2: t. 169 (1905) & in Bull. Jard. Bot. Buitenz., sér. 3, 3:163 (1921).

Type: Java, *Kuhl & van Hasselt* (n.v.).

var. **borneense** R. M. Smith, var. **nov.** a var. *pininga* ligula glabra, pedicellis brevioribus, et staminodiis lateralibus liberis absentibus differt.

Type: Sarawak, 1st Division, Mt Matang, forest mountain slope, c.800m, rhizome on stilt roots, flower red and yellow, petals red, labellum thin, yellow, 7 ix 1967, *Burtt & Martin* B5152 (holo. E).

H. pininga is a common Javan species and is extremely variable in flower colour and indumentum of the foliage. It is characterized by the narrowly fusiform inflorescence which is held aloft on an aerial rhizome. The sterile bracts have much the appearance of *H. scyphifera* but are rough to the touch.

The new variety, which is illustrated in *Notes RBG Edinb.* 31:198, fig. 7 (1972) differs in several respects, notably the absence of free lateral staminodes and the glabrous ligule.

6. *Hornstedtia havilandii* (K. Schum.) K. Schum., Pflanzenr. Zing. 193 (1904)—excl. spec. *Haviland*. Fig. 7A.

Lectotype (selected here): Sarawak, 1st Division, near Pininjau, xi 1865, *Beccari* 1148 (K).

Syn.: *Amomum havilandii* K. Schum. in Bot. Jahrb. 27:303 (1899).

Hornstedtia longipes Ridley in Bot. Jahrb. 44:530 (1910). Type: Kalimantan, *Winkler* 2227 (WRSL).

Material seen:

SARAWAK: 1st Division, G. Manok, Padawan distr., flowers red, 13 v 1975, *Burtt* 8138 (E); B. Jebong, Bau distr., flowers deep pink, inner parts white except base of lower parts, 10 vii 1970, *Lehmann* S29404 (E).

It is unfortunate that *Haviland's* collection (Sarawak: 1st Division, Penkulu Ampat) must be dissociated from the species which bears his name, but the specimen is clearly *H. reticulata* K. Schum. of subgen. *Hornstedtia*. The identification was first made by Ridley (*J. Str. Br. Roy. As. Soc.* 46:240, 1906), who, not having seen the *Beccari* collection,

placed *H. havilandii* in synonymy under *H. reticulata*. The type of *H. havilandii* has not been found at Florence and the Kew isotype was not seen by Schumann, but his rather incomplete description states that *H. havilandii* lacks an anther-crest, thus indicating subgen. *Elettariostemon*. The recent collections match the *Beccari* sheet exactly, as does the holotype of *H. longipes* Ridley.

A further species of *Elettariostemon*, *H. rumphii* (Sm.) Val., is recorded by Valeton (*Bull. Jard. Bot. Buitenz. sér. 3*, 3:170, 1921) as occurring in W Boreno (*Teysmann* 10944, *Hallier* 1894b, n.v.). Valeton remarks that the Bornean plants, which were cultivated at Bogor, had thicker and much longer peduncles than those from Amboina and Ceram. *H. havilandii*, which is characterized by the long (up to c.40cm) peduncles, almost certainly represents the Bornean element of *H. rumphii*, and may be further distinguished from the Moluccan plant by the pronounced sub-apical mucro of the sterile bracts, more or less glabrous and shorter calyx and by the glabrous corolla tube.

7. *Hornstedtia affinis* Ridley in J. Str. Br. Roy. As. Soc. 32:143 (June 1899).

Type: Sarawak, 1st Division, Kuching, *Haviland* 1764 (K).

Syn.: *Amomum phaeochoana* K. Schum. in Bot. Jahrb. 27:304 (Sept. 1899).

H. phaeochoana (K. Schum.) K. Schum., Pflanzenr. Zing. 191 (1904). Type: Sarawak, 1st Division, Kuching, *Beccari* 615 (n.v.).

Schumann's description of *H. phaeochoana* is very incomplete and the type has not been located at either FI or K. Curiously, although he kept the two species apart (on inflorescence size) in his monograph, Schumann determined the type of *H. affinis* as *H. phaeochoana*.

No recent material of *H. affinis* has been seen. The species is small for the genus, the inflorescence not exceeding 10cm to the tips of the flowers; the sterile bracts are more or less glabrous and non-reticulate, ligule and sheath are shaggy haired marginally, and the leaves which dry dark brown are red haired at the margin.

8. *Hornstedtia minor* (Bl.) K. Schum., Pflanzenr. Zing. 199 (Oct. 1904).

Type: Java, *Blume* (L. n.v.).

Syn.: *Elettaria minor* Bl., Enum. Pl. Jav. 53 (1827).

H. minor (Bl.) Val. in Ic. Bog. 2 t. 167 (Dec. 1904). Type: Hort. Bogor, originally from W Borneo.

Bornean material seen:

SARAWAK: 4th Division, G. Mulu National Park, alluvial, c.450m, flowers red, labellum stiff and rigid with white lateral edges, 5 v 1978, *Argent et al.* 888 (E); 7th Division, Hose Mts, B. Salong, flowers dark red outside, white within, 26 iii 1980, *Burt* 12708 (E).

The ribbed felt-like indumentum of the sterile bracts of *H. minor* is quite distinctive. The species is closely allied to the peninsular *H. ophiuchus* Ridley (known only from the type collection Pahang, Tahan R., Ridley s.n., n.v.); this was remarked on by Valeton (1921), who tentatively placed it in synonymy.

Excluded species:

- H. brachychilus* Ridley = *Geanthus* or *Achasma* sp.
H. hewittii Ridley = *Achasma nasutum* (K. Schum.) Loesen.
H. licmeres Ridley = *Achasma nasutum* (K. Schum.) Loesen.
H. sanguinea Ridley = *Geanthus sanguineus* (Ridley) R. M. Smith.
H. sarawacensis (K. Schum.) K. Schum. = *Amomum sarawacense* K. Schum.
H. spathulata Ridley = ?*Achasma metrocheilos* Griff.
H. triloba Ridley = ?*Geanthus* sp.
H. velutina Ridley = *Geanthus* or *Achasma* sp.
H. winkleri Ridley = *Achasma* sp.

2. *Amomum* Roxb.

Amomum is the largest Bornean representative of the tribe *Alpineae* and one which displays considerable diversity of form. The main characteristics of the genus are the compact, usually cone-like inflorescence which is not normally embedded in the soil and the absence of an involucre of sterile bracts. The flowers are, in the majority of cases, borne singly in the axils of prominent bracts, the bracteoles tubular or open to the base and the inflorescence characteristically elongates in fruit, often to a considerable degree.

Schumann (*Pflanzenr. Zing.* 223, 1904) subdivided *Amomum* into two sections and four series: sect. *Geanthus*, distinguished by the ecristate anther and comprising ser. *Geanthus* and *Oliganthus*, and sect. (*Eu*) *Amomum* for species with crested anthers and made up of ser. *Lobulatae* and *Integrae*. The four members of ser. *Geanthus* have been transferred to *Achasma* or *Geanthus*, and ser. *Polyanthae*, while including several true *Amomum*, also contains many little known species from Sulawesi, a number of which should probably be transferred to *Geanthus*. The majority of the much larger sect. *Amomum* is correctly placed generically.

Because *Amomum* is such a widely distributed genus (from the Himalayas to northern Australia) and because several of the species under review here deviate from what may be termed 'typical' *Amomum*, the following informal grouping is proposed for the Bornean species:

Group I. *Flowers borne in cincinni*; bracteoles always tubular; corolla tube equal to the calyx; lateral petals free from the labellum; lateral staminodes absent; *anther-thecae dehiscent in the upper half only*, connective crested or not.

A. lambirensis, *A. ligulatum*, *A. polycarpum*, *A. anomalum*, *A. burtii*.

The presence of cincinni and the restricted dehiscence area of the anther-thecae might indicate that there are reasonable grounds for according generic rank to this small group of species. However, in some inflorescences of *A. anomalum* the bracts appear to be single flowered, only by careful scrutiny can a second, abortive, bud be seen, and it may be that closer inspection of other, seemingly not nearly related species, will reveal similar behaviour. Furthermore, *A. putrescens* Fang (*Acta. Phyt. Sin.* 16:51, 1978) from Guangxi in China, is described as having 3-4 flowers per bract, non-tubular bracteoles and a nine-winged capsule. The bracts and bracteoles are quickly decaying and *A. putrescens* clearly belongs to that group of *Amomum* which includes the Himalayan *A. dealbatum* Roxb., *A. pterocarpum* Thw., from Sri Lanka and the

Australian *A. queenslandicum* R. M. Smith. Neither should the mode of anther dehiscence be considered of generic importance in the Zingiberaceae; this is known to vary within otherwise well defined genera such as *Boesenbergia*, *Hornstedtia* and *Achasma*.

Group II. Flowers borne singly; bracteoles open to the base; corolla tube long exerted from the calyx; lateral petals centrally connate to each other and to the labellum in the lower part; lateral staminodes present or not; anther-thecae dehiscing throughout their length; connective ecrystate.
A. pungens, *A. hansenii*.

Group III. Flowers borne singly; bracteoles open to the base; corolla tube long exerted from the calyx; lateral petals free; lateral staminodes absent; anther-thecae dehiscing throughout their length but with basal spurs which are adnate to the broad filament, connective crested.
A. sarawacense.

Group IV. Flowers borne singly; bracteoles open to the base or tubular; corolla tube more or less equal to or shorter than the calyx; lateral petals free; lateral staminodes almost always present; anther-thecae dehiscing throughout their length, connective usually crested.

A. paucifolium, *A. bicorniculatum*, *A. macroglossum*, *A. coriaceum*, *A. dictyocoleum*, *A. cerasinum*, *A. laxisquamosum*, *A. gyrolophus*, *A. oliganthum*, *A. xanthophlebium*, *A. longipedunculatum*, *A. luteum*, *A. testaceum*, *A. ridleyi* (*A. sylvestre*), *A. flavidulum*, *A. alboflavum*, *A. sp.*

The above species may be regarded as falling within *Amomum* 'proper'. Some clearly defined alliances may be found in this group; notably *A. laxisquamosum* and its related species, all characterized by orange flowers and short cup-shaped tubular bracteoles, and the species surrounding *A. ridleyi* which are usually yellow and white flowered and have open or deeply split bracteoles. Others are less easily placed, and some, due to incomplete material or which are known from description only, must remain problematic at present.

KEY TO THE SPECIES

1. Flowers borne in cincinni; anther dehiscing in upper half only (Group 1)..... 2
- + Flowers borne singly; anthers dehiscing throughout their length..... 5
2. Inflorescence globose (elongating later); bracts firm textured with a short pungent tip; fruit round with a short neck 1. *A. lambirensis*
- + Inflorescence conical, even when young; bracts usually papery, without pungent tips; fruit flask-shaped or round and lacking a neck..... 3
3. Ligule to 3cm long; calyx lobes with prominent subapical spurs; filament present..... 4
- + Ligule 1-2cm long; calyx lobes not subapically spurred; anther sessile 5
4. Flowers orange; peduncle bracts 5 x 3cm; leaves to 5cm wide
2. *A. ligulatum*
- + Flowers white with yellow centre to labellum, peduncle bracts c.4 x 1-1.5cm; leaves 3cm wide or less 3. *A. polycarpum*

5. Leaf tips acute or shortly caudate; flowers c.1-5cm long; anther connective more or less truncate. 4. *A. anomalum*
 + Leaf tips long caudate; flowers 2.5-3cm long; anther connective deeply emarginate with a small appendage in the cleft 5. *A. burttii*
6. Corolla tube slender, long exerted from the calyx; bracts pungent... 7
 + Corolla tube more or less equal to or shorter than the calyx; bracts rarely pungent (Group 4) 9
7. Lateral petals centrally connate to each other and to the labellum in the lower half; anther connective ecristate (Group 2) 8
 + Lateral petals free; anther connective crested (Group 3)
 8. *A. sarawacense*
8. Leaves lanceolate (to 5cm wide); inflorescence up to 7 × 4cm; labellum not exceeding the petals 6. *A. pungens*
 + Leaves linear (to 2cm wide); inflorescence up to 4 × 2cm; labellum much exceeding the petals 7. *A. hansenii*
9. Leaf shoots 3-4-bladed; ligule bilobed 13. *A. paucifolium*
 + Leaf shoots frond-like, many-bladed; ligule rarely bilobed 9
10. Leaf shoot delicate (under 50cm tall); blades linear; fruit echinate
 15. *A. bicorniculatum*
 + Leaf shoot much more robust; blades rarely linear, if so, then fruit not echinate 10
11. Ligule to 6cm long; entire plant glabrous 10. *A. macroglossum*
 + Ligule not exceeding 3cm; plant rarely totally glabrous 11
12. Bracts frilled at margins, with short pungent tips; inflorescence becoming mucilaginous 9. *A. coriaceum*
 + Bracts not as above; inflorescence never becoming mucilaginous 12
13. Anther-crest absent; petiole, leaf-sheaths and sheaths of the peduncle with very conspicuous hairy reticulations 17. *A. dictyocoleum*
 + Anther-crest always well formed; leaf sheaths etc., if hairy reticulate, then not as conspicuously so as above 13
14. Anther-crest entire or shallowly 3-lobed; bracteole distinctly tubular and remaining so 15
 + Anther-crest 3-lobed with well-defined side lobes or the mid-lobe occasionally suppressed; bracteole open to the base or tubular at the base only 18
15. Flowers red and white 16. *A. cerasinum* (ex descr.)
 + Flowers orange 16
16. Leaf sheaths reticulate; anther-crest obscurely 3-lobed; ovary glabrous
 11. *A. laxisquamosum*
 + Leaf sheaths striate; anther-crest semi-lunar; ovary pubescent or verrucose 17
17. Leaves softly hairy below; ovary pubescent 12. *A. gyrolophos*
 + Leaves glabrous; ovary verrucose 14. *A. oliganthum*
18. Bracteole open to the base, firm textured, enfolded round and almost as long as the bract; flowers predominantly orange
 18. *A. xanthophlebium*
 + Bracteole sometimes tubular at the base never approaching the length of the bract; flowers usually yellow and white 19

19. Peduncle to 35cm; ligule bilobed 19. *A. longipedunculatum*
 + Peduncle under 15cm; ligule entire 20
20. Leaves distinctly petiolate (petioles to 3cm); leaves pubescent over entire surface below 20. *A. luteum*
 + Leaves sessile or subsessile; glabrous or pubescent on or around the midrib below 21
21. Leaf sheaths reticulate 22
 + Leaf sheaths striate 23
22. Leaves up to 60 × 10cm; bracts narrowly triangular, papery, markedly striate 22. *A. testaceum*
 + Leaves up to 40 × 6cm; bracts usually broadly triangular, firm, not markedly striate 23
23. Leaf sheaths pubescent; ligule pubescent 23. *A. ridleyi* (*sylvestre*)
 + Leaf sheaths glabrous; ligule glabrous 24. *A. flavidulum*
24. Leaves pubescent on midrib below 21. *A. flavo-album*
 + Leaves glabrous 25. *A. sp.*

1. *Amomum lambirense* R. M. Smith, **species nova** *A. ligulato* calycis lobis sub apice calcaratis et filamentis productis similis, sed floribus breviter pedicellatis, bracteis pungentibus differt. Fig. 8B.

Fronda? *Folia* subsessilia, 50 × 5cm, lanceolata, acuminata, glabra; ligula 6–8mm, integra, coriacea, glabra; vaginae laevis, glabrae. *Inflorescentia* a fronda separatim producta; pedunculus ad 7cm, vaginis 1–2 × 0.6–1cm, glaber, spica 3 × 3cm, globosa, frutescens ad 6cm elongata; bracteae c.2 × 1.5cm, sub apices breviter pungentes, marginibus crispatis, cincinnum saltem triflorum subtendentes; bracteola ad 1cm, basi tubularis. *Flores* pallide lutei, brevissime pedicellati; calyx c.1cm, trilobus, lobis ad apices pubescentibus subapicibus breviter calcaratis; corolla extra pubescens, tubo calyci aequali; lobi laterales 4 × 2mm, rotundati, dorsalis 4 × 3mm; labellum c.7 × 6mm, breviter unguiculatum, medio carnosum, ad basin intus parce pubescens; staminodia lateralia 0; stamen 6mm, filamentum brevissimo pubescente, thecis 3mm in dimidio superiore dehiscentibus pubescentibus; connectivum in cristam 2mm integram; glandulae epigynae dorsofissae; ovarium 2mm, glabrum. *Fructus* 1/3cm, globosus.

Type: Sarawak, 4th Division, Lambir National Park, Sungei Liam Libau, pale yellow flower, centre of lip deeper yellow, 19 ix 1978, *Burt* 11525 (holo. E).

The shortly pungent bracts of *A. lambirense*, with their frilled margins, well distinguish it from its allies and are not unlike those of *A. coriaceum* (no. 8 below) but in that species the inflorescence is long pedunculate and the flowers are borne singly.

2. *Amomum ligulatum* R. M. Smith, **species nova** *A. lambirensi* calycis lobis sub apice calcaratis et filamentis productis similis, sed floribus longe pedicellatis, bracteis non pungentibus differt.

Fronda foliosa 2.5m alta. *Folia* subsessilia, 25–80cm × 3–5cm, anguste lanceolata, longe caudata, glabra; ligula ad 3cm longa, integra, membranacea, glabra. *Inflorescentia* a fronda separatim producta;

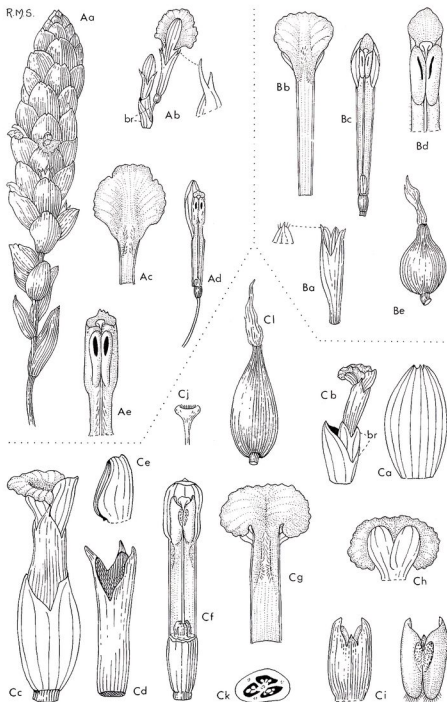


FIG. 8. A. *Amomum polycarpum*. Aa, inflorescence $\times 1$; Ab, cincinnus, removed from bract, showing tubular bracteoles (br) $\times 1$; Ac, Ad, flower, dissected $\times 2$; Ae, stamen, stigma and upper part of style $\times 4$. (from dried material of *Burt* 11589). B. *Amomum lambrense*. Ba, calyx $\times 2$; Bb, Bc, flower, dissected $\times 2$; Bd, stamen, stigma and upper part of style $\times 4$; Be, capsule $\times 1$ (from spirit material of *Burt* 11525). C. *Amomum burttii*. Ca, bract $\times 1$; Cb, cincinnus, bract removed, showing tubular bracteoles (br) $\times 1$; Cc, flower, with bracteole $\times 2$; Cd, calyx $\times 3$; Ce, dorsal corolla lobe $\times 2$; Cf, Cg, flower dissected $\times 2$; Ch, lateral petals and labellum $\times 2$; Ci, stamen from front (r) and rear (l) $\times 4$; Cj, stigma $\times 4$; Ck, ovary in T.S. $\times 3$; Cl, capsule $\times 1$. (from spirit material of *Burt* 12881).

pedunculus ad 10cm; vaginae 5 × 2.5cm, glabrae; spica c.12 × 4cm, anguste elliptica; bracteae c.2 × 1.5cm, apicibus rotundatis, glabrae, cincinnum saltem biflorum subtendentes. *Flores* flavo-aurantiaci, pedicellis ad 1cm longis; calyx 1cm longus, trilobus, lobis calcare valido subapicali praeditis; corolla tubo calyce plus minusve aequilongo, lobis?, labello?; stamen c.0.5cm, filamentum brevi, thecis in dimidio superiore dehiscentibus connectivo in cristam undulatam c.1mm longam prolongato; ovarium c.4 × 2mm, glabrum. *Fructus* 2 × 1.5cm, ovoideus, pallide brunneo-aurantiacus (fide collectoris).

Type: Sabah, Kimanis to Keningau rd, Crocker Range, submontane forest, c.1200m, perianth green, rest of flower orange with darker orange spot on labellum, 18 ii 1980, *Argent* 1320 (holo. E).

The type collection of *A. ligulatum* is not wholly satisfactory as no entire flowers remain on the herbarium material. However, an excellent colour slide shows clearly the broad labellum and prominent subapical lobes of the calyx.

3. *Amomum polycarpum* (K. Schum.) R. M. Smith, **comb. nov.** Fig. 8A.

Type: Sarawak, 4th Division, Tubao, Bintulu, 1867, *Beccari* 3729 (K).

Syn.: *Alpinia polycarpa* K. Schum. in Bot. Jahrb. 27:298 (1899) & in Pflanzenz. Zing. 367 (1904).

Languas polycarpa (K. Schum.) Merr. in Univ. Calif. Publ. Bot. 15:35 (1929).

Plagiostachys polycarpa (K. Schum.) Loesen., Pflanzenfam. Aufl. 2, 15a: 627 (1930).

Other material seen:

SARAWAK: 4th Division, Lambir National Park, Sungei Liam Libau, streamside, rock crevices, flower white with yellow centre to lip below tip, 22 ix 1978, *Burt* 11589 (E).

A. polycarpum is very closely allied to *A. ligulatum*, which it resembles in the long pedicelled flowers, apiculate calyx lobes and prominent ligules. It is however a less robust plant with linear-lanceolate leaves and white rather than orange flowers. The spherical capsules are just over 1cm in diameter.

4. *Amomum anomalum* R. M. Smith in Bot. J. Linn. Soc. 85:61, fig. 16 (1982).

Type: Sarawak, 4th Division, Gunung Mulu National Park, camp 2, SW of camp, 400m, 17 ii 1978, *Hansen* 368 (holo. C).

Recent Bornean material seen:

SARAWAK: 7th Division: Ulu Belaga, S Semawat, c.250m, hill Dipterocarp forest, low clayey bank by river, bracts green with brown margin, flowers dark yellow on large lobe, purplish brown elsewhere, 15 x 1981, *Hansen* 632 (C); *ibidem*, open area by stream, old fruit orange, *Hansen* 680 (C, E). See Smith (op. cit.) for additional citations.

To date, *A. anomalum* is the most widespread of this group of *Amomum*, collections have been made from Mt Murud, Sungei Bena (Kapit) and the Linau Balui divide in Belaga district; it has not yet been

recorded outside Sarawak. The cincinni are borne extremely densely on the main axis and the infructescence may elongate to 35cm. The flowers are yellow with some purple and the flask shaped fruit is red.

5. *Amomum burttii* R. M. Smith, species nova *A. anomalum* anthera sessili et fructibus asciformibus similis, sed floribus majoribus et crista connectivi profunde emarginata in sinu lobulum gerente differt. Fig. 8C.

Fronda foliosa ad 2m alta. *Folia* sessilia, 45–50 × 8cm, lanceolata, caudata, glabra, ligula c.1cm, coriacea, integra, glabra; vaginae obscure reticulatae, glabrae. *Inflorescentia* a fronda separatim producta; pedunculus 12–16cm; vaginae 4 × 1.5cm, acuminatae, crebre reticulatae, minute pubescentes; spica 12 × 4cm, anguste cylindrica; bracteae c.3 × 1.5cm, apice rotundatae et minute ciliatae, cincinnum saltem biflorum subtendentes; bracteolae c.1.5cm, tubulares, bilobae, glabrae. *Flores* lutei, brevissime pedicellati; calyx 2cm longus, trilobus, lobis carnosus; corolla tubo calyci aequilongo intus fauce pubescente; lobi laterales c.0.7cm longi, rotundati, dorsalis paulo major, galeatus; labellum 0.6 × 1.2cm, integrum, marginibus crispatis; anthera sessilis, 0.6cm longa, in dimidio superiore tantum dehiscentibus, connectivo profunde emarginato lobulum minutum in sinu gerente; stigma ore ciliatum; glandulae epigynae stylum circumcingentes; ovarium 5–6mm glabrum. *Fructus* 2.5cm longus, asciformis, costatus, glaber.

Type: Sarawak, 7th Division, S Hose Mrs, camp V, Uju Melinau, c.4500ft, flowers yellow, 13 iv 1980, *Burt* 12881 (holo. E).

In general habit *A. burttii* is similar to *A. anomalum* but may be easily distinguished by the less densely congested cincinni and much larger flowers. The anther connective is curious; it is deeply emarginate with a tiny tooth-like appendage, which is just visible from the front, arising in the base of the cleft.

The species is named after Mr B. L. Burt with grateful thanks for his continuing interest in the Zingiberaceae.

6. *Amomum pungens* R. M. Smith, species nova *A. hansenii* R. M. Smith bracteis spinescentibus, petalis lateralibus connatis et anthera sessili similis, sed foliis lanceolatis et inflorescentia elongata differt. Fig. 9C.

Fronda foliosa e rhizomate radicibus fulcentibus elevato oriens; folia sessilia vel brevissime petiolata, 30–45 × 4–5cm, anguste lanceolata, caudato-acuminata, inferne breviter pubescentia; ligula 3–5mm, pilosa, integra; vaginae obscure reticulatae pilis brevibus paucis praeditae. *Inflorescentia* a fronda separatim producta; pedunculus 3–5cm; vaginae ad 5 × 3cm, ovatae, breviter et dense pubescentes, apice pungentes; spica ad 7 × 4cm, ovata; bracteae 3–4cm × 2cm, apice in spina ad 5mm longa prolongata; bracteolae c.1cm longae, ovatae, ad basin apertae. *Flores* albi vel cremei; calyx c.2cm, unilateraliter profunde fissus, breviter bidentatus; corollae tubus 3cm paulo excedens, intus leviter pubescens; lobus dorsalis 1 × 0.8cm ovatus, rotundatus; lobi laterales 6 × 4cm inter se et ad medium labellum per dimidium longitudinis connati; labellum c.8 × 4mm, integrum, apice rotundato; staminodia lateralia e dentibus brevibus subulatis; anthera sessilis, thecis c.6mm, connectivo truncato; stigma ore

R.M.S.

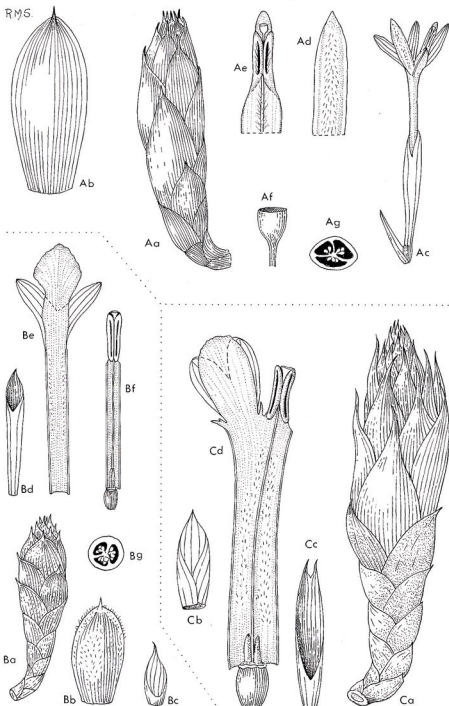


FIG. 9. A. *Anomum sarawacense*. Aa, young inflorescence $\times 1$; Ab, bract $\times 1$; Ac, flower and bracteole $\times 1$; Ad, labellum $\times 2$; Ae, stamen, stigma and upper part of style $\times 2$; Af, stigma $\times 6$; Ag, ovary in T.S. $\times 3$ (from dried material of S30713). B. *Anomum hanseni*. Ba, young inflorescence $\times 1$; Bb, bract $\times 2$; Bc, bracteole $\times 2$; Bd, calyx $\times 2$; Be, Bf, flower, dissected $\times 1$; Bg, ovary in T.S. $\times 3$ (from spirit material of Hansen 656). C. *Anomum pungens*. Ca inflorescence $\times 1$; Cb, bracteole $\times 2$; Cc, calyx $\times 2$; Cd, flower, dissected $\times 2$ (from spirit material of Hansen 919).

ciliatum; glandulae epigynae 2mm, inter se liberae; ovarium 2-3mm, glabrum, triloculare placenta axili. *Fructus* ignotus.

Type: Sarawak, 7th Division, Kapit distr., S Bena area, stream gully banks, leaves ridged, white flowers, 23 iv 1980, *Burt* 12944 (holo. E).

Other material seen:

SARAWAK: 4th Division, Lambir National Park, S Liam Libau, streambank, flower cream, the lip a little darker, some stilt roots, 18 ix 1978, *Burt* 11500 (E); 7th Division, Ulu Belaga, S Semawat, wet stream bank in logged hill dipterocarp forest, rhizome elevated above ground by stilt roots, bracts pale green, flowers white, 31 x 1981, *Hansen* 919 (C, E).

7. *Amomum hansenii* R. M. Smith, *species nova*. *A. pungenti* bracteis spinescentibus, petalis lateralibus connatis, anthera sessili similis, sed foliis linearibus, inflorescentia multo minore, labello longiore differt. Fig. 9B.

Fronda foliosa 0.5-0.75m, folia sessilia, ad 30 x 2cm, linearia, longe caudata, ad basin valde attenuata, subtus breviter pubescentia; ligula 1-2mm, villosa-pilosa; vaginae striatae, ad margines dense villosa-pilosae. *Inflorescentia* a fronda separatim producta, brevissime pedunculata, 3-4 x 1.5-2cm, strobilacea; bractee virides, 2 x 1.5cm, ovatae, pubescentes, apice brevi spinescente, florem singulum subtendentes; bracteolae 5-7mm, basi tubulares, acuminatae. *Flores* albi; calyx 1.5cm, acutus, lateraliter breviter fissus; corolla tubo calycem paulo excedente intus leviter pubescente; lobus dorsalis 1.2 x 0.4cm lanceolatus, laterales inter se et ad medium labellum per dimidium longitudinis connati; labellum 1.5cm longum, parte triente superiore c.6mm inferne 4mm latum; staminodia lateralia 0; anthera sessilis, thecis c.6mm, connectivo in cristam undulatum prolongato; stigma cupiforme; glandulae epigynae 4mm, lineares; ovarium 3mm glabrum, triloculare, placenta axillari. *Fructus* ignotus.

Type: Sarawak, 7th Division, Ulu Belaga, S Semawat, hill dipterocarp forest, gentle clayey slope by river, bracts green, flowers white, 17 x 1981, *Hansen* 656 (holo. C).

Other material seen:

SARAWAK: *ibidem*, bracts green, flowers white, 15 x 1981, *Hansen* 620 (C).

The spine-tipped bracts are a striking feature of *A. pungens* and *A. hansenii*. These species are very closely related, and the manner in which the lateral corolla lobes are connate to each other and to the centre of the labellum in the lower third, as in *Zingiber* and some *Hornstedtia*, is unique in *Amomum*. The much larger dimensions of the inflorescence, which is held above ground on stilt roots, lanceolate rather than linear leaves, presence of lateral staminodes and the shape of the labellum well differentiate *A. pungens* from *A. hansenii*. Two Sumatran species, also with pungent bracts may be allied; they are, *A. apiculatum* K. Schum. and *Geanthus echinatus* Val. Material of both has been seen and both differ vegetatively from the Bornean plants; unfortunately no flowers are available for dissection but Valetton's species, which is misplaced in *Geanthus* is figured in *Bull. Jard. Bot. Buitenz. sér. 3, 3:t. 8* (1921) and shows the flower to be remarkably similar to that of *A. pungens*. No mention is made by Valetton of connate lateral petals, but this character might easily be overlooked.

It is a pleasure to name this species after Dr Carlo Hansen, whose recent Bornean collections have been of a very high standard.

8. *Amomum sarawacense* K. Schum. in Bot. Jahrb. 27:304 (1899). Fig. 9A
Type: Sarawak, 1st Division, Mt Matang, iv 1865/68, *Beccari* 1434 (n.v.).
Syn.: *Hornstedtia sarawacensis* (K. Schum.) K. Schum., Pflanzenr. Zing.
191, fig. 42 N (1904).

The following collection may belong here:

SARAWAK: 4th Division, swamp between Ulu Sungei Karap and Batang Tinjar, peat swamp forest, up to 1m, inflorescence on short head arising from base of stem, bracts pink, corolla white tinged pink, very abundant, 18 ix 1971, *Anderson* S30713 (E).

The type of *Amomum sarawacense* has not been located and Schumann's description lacks any floral detail, but the spine-tipped bracts, shape of the inflorescence and much vegetative detail of the recent collection are as figured and described. If the above determination is correct and had Schumann seen better material, he would not have transferred his species to *Hornstedtia*; for there is no involucre of sterile bracts, the outstanding characteristic of that genus. None the less the flowers display a certain similarity to some *Hornstedtia*; the corolla tube is long and slender, the lip is narrow, rather fleshy but with a membranous margin and the anther-thecae are prolonged at the base into sterile spurs which are adnate to the margins of the broad filament. The bracteoles are open to the base, there are no lateral staminodes, and the anther connective is prolonged into a prominent, rounded, entire crest.

9. *Amomum coriaceum* R. M. Smith in Bot. J. Linn. Soc. 85:61, fig. 15A (1982).

Syntypes: Sarawak, 1st Division, Mt Matang, *Beccari* 2947 (n.v.); Mt Santubong, *Beccari* 2162 (FI).

Syn.: *Alpinia cylindrostachys* K. Schum. in Bot. Jahrb. 27:299 (1899) & Pflanzenr. Zing. 366 (1904)—non *Amomum cylindrostachys* Ridley. Syntypes as above.

Other material seen:

SARAWAK: 4th Division: Gunong Mulu National Park, camp 5, Melinau Gorge, S of Sungei Melinau, 200m, steep slope in lowland dipterocarp forest, 28 i 1978, *Hansen* 196 (C); Lambir National Park, Sungei Liam Liban, stream bank, frond 2m with some stilt roots, 13 ix 1978, *Burt* 11497 (E). 7th Division, Kapit district, Belega, faintly aromatic, 2m, inflorescence very slimy, bracts red margined, green tipped, calyx reddish, corolla very thin, pale reddish-white towards top, lip bright yellow, paler towards the top, stamen very pale yellow-reddish, 24 viii 1958, *Jacobs* 5263 (K).

A. coriaceum seems closely allied to *A. squarrosun* Ridley of the Malay Peninsula: both species may develop stilt roots, the shape of the inflorescence is similar and it becomes mucilaginous with age. *A. coriaceum*, however, differs in the firmer textured pubescent bracts, very obscurely three-lobed labellum and in the anther-connective, which is

emarginate but with a lateral appendage arising subapically on each thecae.

10. *Amomum macroglossum* K. Schum. in Bot. Jahrb. 27:314 (1899) & in Pflanzenr. Zing. 231 (1904).

Type: Sarawak, Mt Matang, *Beccari* 2077 (FI).

Other material seen:

SARAWAK: 1st Division, Mt Matang, flowers yellow, streaked red, cone green, vii 1898?, *Ridley* 11801 (K).

A. macroglossum also occurs in the Malay Peninsula, and is readily recognized by the prominent ligule (up to 6cm long) and by the totally glabrous character of the entire plant. These features distinguish it from *A. coriaceum* which it resembles in inflorescence shape, flower colour and the presence of stilt roots.

11. *Amomum laxisquamosum* K. Schum. in Bot. Jahrb. 27:315 (1899) & Pflanzenr. Zing. 238 (1904); R. M. Smith in Bot. J. Linn. Soc. 85:65, fig. 15B (1982).

Type: Sarawak, Kuching, *Beccari* 386 (FI).

Other material examined:

SARAWAK: 1st Division, Padawan District, Gunung Manok, stream valley, orange-red flowers, frond to 10ft, 13 v 1975, *Burt* 8121 (E). 4th Division: Gunung Mulu National Park, between Sungei Melinau and Sungei Tarikan, flower wholly orange, anther-crest depressed into labellum, inside of crest and stigma white with red spots, anther white, 15 vi 1975, *Burt* 8276 (E); *ibidem*, Gua Payau, c.100m, vigorous clump, flowers dull orange, 19 xi 1977, *Argent & Kerby* 808 (E).

SABAH: Elphinstone province, Tawao, 1922/1923, *Elmer* 20459 (UC); *ibidem*, *Elmer* 20862 (UC).

No flowers remain on the type specimen but there is little reason to dissociate the above material from *A. laxisquamosum*. The species is characterized by the reticulate leaf sheaths, orange flowers, obscurely 3-lobed crest and spherical, ribbed fruit. The very short tubular bracteole is thin textured and is tightly clamped around the lower part of the calyx.

12. *Amomum gyrolophos* R. M. Smith, *species nova* *A. laxisquamoso* bracteolis brevissimis tubularibus, crista antherae conspicua, floribus aurantiacis similis, sed vaginis foliorum striatis, staminodiis lateralibus nullis, ovario pubescente differt. Fig. 10B.

Fronda foliosa; petioli c.1.5cm longi, pubescentes; lamina 20 × 6cm, lanceolato-caudata, basi inaequali, subtus molliter pubescens; ligula ad 1cm, coriacea, integra, dense pubescens; vaginae striatae, parce pubescentes et membranaceo-marginatae. Inflorescentia a fronda separatim producta; pedunculus c.7cm, squamis c.3 × 1cm lanceolatis ad bases pubescentibus; spica 6 × 5cm; bractee c.2 × 3cm, ovatae, obtusae, apicem versus inflorescentiae angustiores, pubescentes saltem ad bases; bracteolae minus quam 1cm, tubulares, tenuissimae. Flores aurantiaci (?); calyx ad 2cm, unilateraliter breviter fissus, 3-lobus, glaber; corolla tubo calyci aequilongo; lobi laterales 2 × 0.5cm, dorsalis 2.5 × 1.5cm, carinatus,

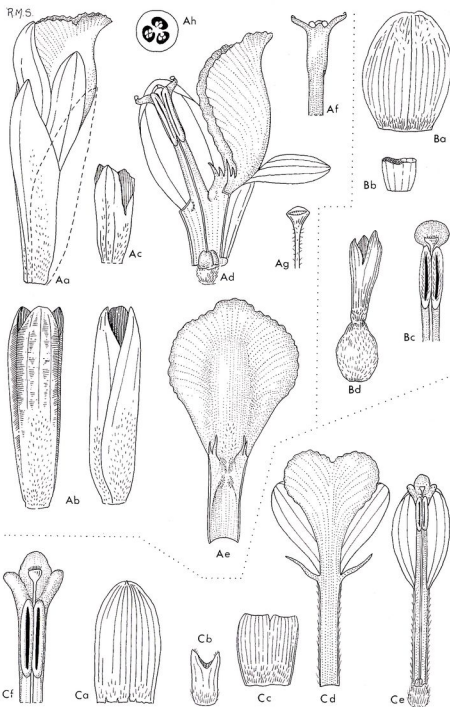


FIG. 10. A. *Amomum xanthophlebium*. Aa, flower with bracteole, position of bract indicated by broken line, $\times 1$; Ab, bracteole, dorsal and ventral views $\times 1$; Ac, calyx $\times 1$; Ad, flower, dissected $\times 1$; Ae, labellum, lateral staminodes and corolla tube $\times 1$; Af, rear view of anther $\times 1$; Ag, stigma $\times 3$; Ah, ovary in T.S. $\times 2$ (from spirit material of *Burt & Martin* B5159). B. *Amomum gyrolophos*. Ba, bract $\times 1$; Bb, bracteole $\times 1$; Bc, anther, stigma and upper part of style $\times 1$; Bd, young fruit surmounted by calyx $\times 1$ (from dried material of *Burt & Martin* B4756). C. *Amomum paucifolium*. Ca, bract $\times 1$; Cb, bracteole $\times 1$; Cc, calyx, dissected $\times 1$; Cd, Ce, flower, dissected $\times 1$; Cf, anther, stigma and upper part of style $\times 2$ (from spirit material of *Burt* 11341).

rotundatus; labellum $c.3 \times 1.5$ cm, basi angustata, medio aurantiaco, lobis lateralibus latis mediano minore 5×5 mm, marginibus crispatis; staminodia lateralia nulla; stamen $c.3$ cm; filamentum 2cm; anthera 8mm, thecis pubescentibus, connectivo in cristam 2×3 mm rotundatam cucullatam prolongato; ovarium 5mm, dense pubescens. Fructus ignotus.

Type: Sarawak, 1st Division, Semengoh Forest Reserve, labellum frilled at edges, centre orange, anther-crest a rounded hood, 26 vii 1867, *Burt & Martin* B4756 (holo. E).

A. gyrolophos differs from *A. laxisquamosum* in the striate rather than reticulate leaf sheaths, absence of lateral staminodes and pubescent ovary. The lower surface of the leaves is densely and softly hairy.

13. *Amomum paucifolium* R. M. Smith, *species nova* *A. laxisquamosae* floribus aurantiacis et bracteola brevi tubulari similis, sed fromda paudifoliata, ligula biloba, inflorescentia minore differt. Fig. 10C.

Fronda usque ad 60cm. *Folia* 3-4, sessilia, 15-20 \times 3-5.5cm, lanceolata vel elliptico-lanceolata, caudata, subtus parcissime et breviter pubescentia; ligula 3mm, e lobis duobus rotundatis, coriacea, ciliato-marginata; vaginae reticulatae marginibus parce pubescentes. *Inflorescentia* brevissime pedunculata, e basi foliosa oriens, $c.5 \times 2$ cm, depauperata; bractee $c.3 \times 2$ cm, oblongae, rotundatae, mucrone subapicali praeditae, breviter et molliter pubescentes; bracteolae $c.1.5$ cm, tubulares, bilobi, parce pubescentes. *Flores* aurantiaci; calyx 1.5cm, truncatus, unilateraliter fissus, leviter pubescens; corolla tubo 2.5cm longo; lobi 2×1 cm, dorsalis latior; labellum 3×2 cm, unguiculatum, limbo leviter bilobo; staminodia lateralia 1cm longa, linearia; stamen $c.2.5$ cm; filamentum $c.1.3$ cm; thecae 8mm; connectivum in cristam 4×6 mm trilobam prolongatum; stigma ore ciliatum; glandulae epigynae 3mm, truncatae, inter se liberae; ovarium 6mm longum, dense sericeo-pubescent. *Fructus* ignotus.

Type: Sarawak, 7th Division, Belaga Distr., near Punan Lusong, B. Dema, base of tree trunk, orange flowers, 28 viii 1978, *Burt* 11341 (holo. E).

The short tubular bracteole, obscurely 3-lobed anther crest and orange flowers of *A. paucifolium* suggest an affinity with *A. laxisquamosum* and *A. gyrolophos* from which it differs in the few leaved shoots, smaller inflorescence and bilobed ligule.

Few bladed leaf shoots are associated with the genus *Elettariopsis* and are almost unique in *Amomum*, but the leaves of *A. paucifolium* lack the long petioles of *Elettariopsis*, and much inflorescence and floral detail—for example, tubular bracteoles, the well-formed lateral staminodes and cup-shaped stigma—further distinguish it from that genus.

14. *Amomum oliganthum* K. Schum. in Bot. Jahrb. 27:321 (1899) & Pflanzenr. Zing. 244 (1904); *Burt & Smith* in Notes RBG Edinb. 31:310 fig. 1 (1972).

Type: Sarawak, 1st Division, Mt Matang, xii 1866, *Beccari* 2946 (FI).

Syn.: *A. hewittii* Ridley in J. Str. Br. Roy. As. Soc. 46:238 (1906).

Syntypes: Sarawak; Mt Matang, *Ridley* s.n. (n.v.); Mt Santubong, *Hewitt* s.n. (n.v.).

A. gracilipes K. Schum., Pflanzenr. Zing. 252 (1904). Type: Borneo, without precise locality, *Korthals* s.n. (L).

Other material seen:

SARAWAK: 1st Division, Semengoh Forest Reserve, bracts green, flowers dull orange yellow, base and apex of lip somewhat darker, 13 vii 1962, *Burt & Woods* B2478 (E); 3rd Division, Bukit Mabong, labellum orange in centre, petals red, fruits warted, 5 viii 1967, *Burt & Martin* B4811 (E).

A. oliganthum differs from *A. laxisquamosum* and its allies in the long pedunculate inflorescence and verrucose ovary which develops into an echinate capsule. The collection from Bukit Mabong has larger leaves and red, rather than orange petals. The bracteole is short and tubular and the anther-crest semi-lunar.

15. *Amomum bicorniculatum* K. Schum., Pflanzenr. Zing. 229 (1904). Type: Kalimantan, G. Sakambang, *Korthals* s.n. (L).

No further material of *A. bicorniculatum* has been seen. Vegetatively the species is very distinct; the extremely delicate leaf shoot, which is no more than 40cm tall, is composed of sessile, linear blades measuring a mere 12–18 × 0.5–1.5cm. The small infructescence is borne on a weak 9cm peduncle and the echinate capsules are exactly as in *A. oliganthum*. Schumann described the flowers in detail but none remain on the type collection. He states that the bracteole is subturbinate and 1cm long, the calyx shortly bilobed with subapical spurs and equal to the calyx in length. These characters might indicate that *A. bicorniculatum* is no more than a depauperate form of *A. oliganthum*, but the short filament and ecristate anther attributed to the former suggest that the species be kept apart.

16. *Amomum cerasinum* Ridley in J. Str. Br. Roy. As. Soc. 45:237 (1906). Type: Sarawak, Mt Matang, *Ridley* 12421 (n.v.).

The type of *A. cerasinum* has not been located at SAR, SING or K. Ridley described a plant with a cherry red corolla, white and red labellum, semi-lunar anther crest and a globose capsule. These characters, and the vegetative detail given by Ridley do not correspond to any recent collections. In his description he refers to an 'epicalyx tubular $\frac{1}{2}$ an inch long with 3 ovate lobes'. If this is taken to indicate a short tubular bracteole *A. cerasinum* may perhaps be related to the otherwise orange flowered species of the *A. laxisquamosum* alliance.

17. *Amomum dictyocoleum* K. Schum. in Bot. Jahrb. 27:312 (1899) & Pflanzenr. Zing. 231 (1904).

Type: Sarawak. 1st Division, Kuching, ix 1865, *Beccari* 799 (K).

Other material seen:

SARAWAK: 1st Division, Semengoh Forest Reserve, orange flowers, 24 vii 1967, *Burt & Martin* B4277 (E).

Many *Amomum* have reticulate-areolate leaf sheaths, but in *A. dictyocoleum* the reticulations are particularly striking and extend onto the petioles and base of the midrib; the peduncle sheaths are similarly marked. The bracts of the more or less rounded inflorescence are papery and straw coloured when dry. There is no anther-crest.

Amomum sp. (aff. *A. dictyocoleum*)

SARAWAK: 7th Division, S Hose mts, camp iv, Ulu Melinau, c.1100m, in riverside forest, fronds stout with markedly reticulate sheaths, flowers apparently cream with yellow labellum, 15 iv 1980, *Burt* 12900 (E).

Although the (longer) petioles are less strikingly reticulate, the above collection is remarkably similar to *A. dictyocoleum* in general facies. Only unopened flowers are available for examination they agree with *A. dictyocoleum* in the large bracteole, which is tubular at the base only, but differ most notably in the presence of a three-lobed anther crest, the linear spatulate lateral lobes of which are (at least at this stage of development) held erect. This plant almost certainly represents yet another new species.

18. *Amomum xanthophlebium* Bak. in Hook.f. Fl. Brit. Ind. 6:241 (1892); K. Schum., Pflanzenz. Zing. 251 (1904). Fig. 10 A.

Type: Malay Peninsula, Malacca, *Maingay*, Kew distribution No. 1585 (K).

The following material probably belongs here:

SARAWAK: 1st Division, Semengoh Forest Reserve, lip orange with darker lines, 14 ix 1967, *Burt* & *Martin* B5159 (E); 4th Division, Lambir National Park, ridge of Bukit Lambir, 2m, spent heads only, 25 ix 1978, *Burt* 11614 (E).

KALIMANTAN: NE but without precise locality, xii 1912, *Amdjah* 1013 (K).

The material cited above differs from *A. xanthophlebium* as it occurs in the Malay Peninsula in the orange, rather than red and yellow streaked labellum, and in the much reduced midlobe of the prominent anther-crest. In other respects the Bornean collections match the peninsular plant very well. It is a large flowered species, readily distinguished from other Bornean *Amomum* by the firm textured, bicarinate bracteole which is almost as long as the bract, open to the base and wrapped tightly round the flower, the free edges overlapping. *A. spiceum* Ridley (Malay Peninsula) is closely related.

19. *Amomum longipedunculatum* R. M. Smith, *species nova* *A. luteo* crista triloba, corollae lobis et ovario pubescentibus similis, sed pedunculo longiore tenui, inflorescentia plus minusve globosa et ligula biloba differt.

Fronda foliosa c.1.3m alta, e rhizomate radicibus fulciantibus elevato oriens. Folia petiolata, petiolis 0.5-1.5cm; lamina 16-23cm, lanceolata, caudato-acuminata, marginibus ad apices exceptis glabra; ligula 3mm, pubescens, in lobos duos rotundatos divisa; vaginae striatae, pubescentes. Inflorescentia a fronda separatim producta, pedunculo 30-35cm longo tenui, omnino breviter pubescens; squamae 2-5 x 1cm; spica c.3 x 3cm, globosa; bractae c.2 x 0.5cm, lanceolatae; bracteolae c.1cm, basi tubulari. Flores cremei, foetidi; calyx 1cm, unilateraliter breviter fissus, obscure trilobus, marginibus breviter ciliatis; corollae tubus calyci aequalis; lobi c.1cm longi, dorsalis aliis latior, apicibus rotundati, pubescentes; labellum 1.5 x 1.3cm, late ovatum, trilobum, lobo mediano parvo emarginato; staminodia lateralia c.2mm, linearia; stamen c.1.2cm; filamentum 2-3mm; thecae 8mm, connectivo in cristam 3 x 8mm trilobam prolongato; stylus

pubescens; glandulae epigynae c.2mm, truncatae; ovarium 5mm, pubescens. *Fructus* ignotus.

Type: Sabah, Mt Kinabalu, Mesilau R, rain forest, c.1700m, flowers cream with a pink column and nauseous smell, 25 ii 1980, *Argent* 1360 (holo. E).

A. longipedunculatum is a very distinctive species well characterized by the remarkably long peduncle, small globose inflorescence and bi-lobed ligule. The rhizome is held above ground on stilt roots, a condition not common in *Amomum*. The bracteole is tubular at the base only and the 3-lobed anther-crest with its wide spreading side lobes is exactly as in *A. luteum* and *A. flavo-album*.

20. *Amomum luteum* R. M. Smith, species nova *A. longipedunculato* crista triloba, corollae lobis et ovario pubescentibus similis, sed foliis subtus pubescentibus, pedunculo brevior, ligula integra differt.

Fronde foliosa ad 3m alta. *Folia* petiolis 2-2.5cm longis pubescentibus praedita; lamina ad 750×9cm, lanceolata, (apice non viso), subtus imprimis in costa molliter pubescens; ligula c.3mm, dense pilosa; vaginae plus minusve areolatae, breviter pubescentes. *Inflorescentia* a fronda separatim producta pedunculo 9cm longo; rhachis dense tomentosa; vaginae 2.5×2cm ovatae, velutinae; spica c.4×3cm, vertice plus minusve plana; bractee c.1.2×0.8cm, ovatae, papyraceae, glabrae; bracteolae 1.5cm, ut videtur ad basin fissae, glabrae. *Flores* pallide lutei; calyx 1.5cm truncatus, unilateraliter breviter fissus; corollae tubo calyci paulo brevior; lobi laterales 1.5×0.5cm, rotundati, dorsalis longior et latior, omnes extra pubescentes; labellum medio intensius luteum, c.2×1.3cm, obovatum, integrum; staminodia lateralia dentes minutos subulatos formantes; stamen 1.5cm; filamentum 3mm; thecae 8mm, pubescentes, connectivo in cristam 3×8mm trilobam prolongato; stigma ore ciliatum; stylus pubescens: glandulae epigynae 2mm, truncatae; ovarium 3mm, basi annulo pilorum praeditum. *Fructus* ignotus.

Type: Sarawak, 4th Division, Bakelalan to Mt Murud, stream below camp iv, inflorescence from superficial or slightly aerial rhizome system, flowers pale yellow, deeper yellow in centre of lip. 4 x 1967, *Burt & Martin* B5372 (holo. E).

21. *Amomum flavo-album* R. M. Smith, species nova *A. luteo* crista antherae triloba similis sed foliis costa excepta glabris sessilibus et vaginis foliorum striatis differt.

Folia sessilia (vel petiolo c.3mm longo), 21-25×3.5-4cm, anguste lanceolata, caudato-acuminata, subtus in costa pubescentia; ligula 2-3mm, coriacea, integra, glabra; vaginae striatae, glabrae. *Inflorescentia* a fronda separatim producta; pedunculus 8-11cm, vaginis 3-4×2cm acutis glabris, rhachide dense pubescente; spica 2-3×4-5cm vertice plana; bractee c.2×1cm, acutae, breviter et molliter pubescentes; bracteolae c.1cm, ut videtur ad basin apertae. *Flores* pallide, calyx 1cm, irregulariter trilobus; corollae tubus calyci aequalis; lobi c.1.5cm longi, rotundati, dorsalis lateralibus latior, extra parte pubescentes; labellum c.1.75×1.3cm, in medio, luteum, plus minusve integrum; staminodia lateralia tumores carnosos formantia; stamen c.1.75cm; filamentum 4mm; anthera 7mm,

connectivo in cristam conspicuam 5×10 mm trilobam prolongato; stylus parce pubescens; stigma ore ciliato; glandulae epigynae c. 5 mm, truncatae, basem styli circumcingentes, dorsaliter fissae; ovarium 3 mm, glabrum. *Fructus* ignotus.

Type: Sarawak, 4th/5th Division boundary, Bakelalan to Mt Murud, W of camp iv, 28 ix 1967, *Burt & Martin* B5283 (holo. E).

Other material seen.

SARAWAK: *ibidem*, ridge W of camp iv, epiphyte on base of mossy trunks, flowers white translucent, centre of lip yellow, 2 x 1967, *Burt & Martin* B5351 (E).

A. luteum and *A. flavo-album*, which occur in the same area, are very closely related. Much inflorescence detail is common to both species but vegetatively *A. flavo-album* is easily distinguished by the considerably narrower, almost glabrous, sessile leaves, the glabrous ligule and striate rather than areolate leaf sheaths.

The bracteoles of both type collections are open to the base, those of B5351 are shortly tubular in the lower part but in no way resemble the cup-shaped bracteoles of the *A. laxisquamosum* alliance.

An illustration, taken from type material of *A. flavo-album* may be found in *Notes RBG Edinb.* 31:196, fig. 6 (1972)—sub *A. sp.* sect. *Amomum* series *Lobulatae*.

22. *Amomum testaceum* Ridley in J. Str. Br. Roy. As. Soc. 32:137 (1899); Merrill in Univ. Calif. Publ. Bot. 25:31 (1929).

Type: Malay Peninsula, Selangor, caves, Kuala Lumpur, *Ridley* 8173 (K). Bornean material seen:

SABAH: Elphinstone province, Tawao, 1922/23, *Elmer* 20645 (UC); Myburgh province, Sandakan, x-xii 1921, *Elmer* 20229 (UC).

The above collections match the peninsular material of *A. testaceum* very well. The species lies close to *A. ridleyi* and *A. flavo-album*, but is readily distinguished by the extremely papery, buff coloured bracts which are strongly marked by longitudinal striations.

23. *Amomum ridleyi* R. M. Smith, *nom. nov.*

A. sylvestre Ridley in J. Str. Br. Roy. As. Soc. 46:236 (1906)—non *A. sylvestre* Lamarck (1783)—non *A. sylvestre* Sw. (1788).

Ridley states that this species is 'common in the woods at Kuching' but cites no actual collection. He remarks that one plant had two complete anthers and so the following may be taken to represent type material:

SARAWAK: 1st Division, Kuching, stamens 2, lip yellow bar up centre otherwise flower white, staminodes long, 1893, *Ridley* s.n. (SING).

Other material seen:

SARAWAK: 1st Division: Kuching, path to Siol, 7 xi 1905, *Hewitt* series 231 (SAR); Gunung Bewan, Padawan district, forming clumps on stilts, flowers white with yellow patch in middle of labellum and pink filament, 14 v 1975, *Burt* 8143 (E). 4th Division, Gunung Mulu National Park, Sungei Tutoh, bracts brown, all parts of flower pale brown, except the lip which is yellow, 1978, *Hansen* 393 (C).

Only old shrivelled flowers are to be found on the Ridley and Hewitt sheets. The recent collections differ from the original description in the truncate calyx, glabrous corolla lobes and in the presence of a central lobe to the anther crest but the calyx of Ridley's 1893 plant shows no distinct lobing. In general facies, the small rounded inflorescence, papery bracts, reticulate leaf sheaths and narrowly lanceolate leaves, all the collections are similar and until new material of *A. ridleyi* is available from the type locality, and certain points from Ridley's description checked, it seems unwise to describe yet another new species.

24. *A. flavidulum* Ridley in J. Str. Br. Roy. As. Soc. 46:236 (1906).
Type: Sarawak, 1st Division, Mt Matang, vii 1899?, Ridley 11802 (K).

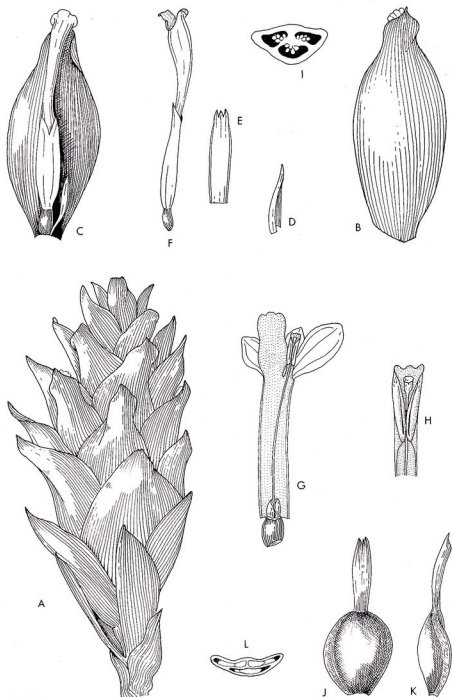
The cylindrical inflorescence of *A. flavidulum* is borne on a peduncle up to 14cm long, the leaves are broadly lanceolate, the ligule prominent and the leaf sheaths reticulate. The flowers are described as reddish yellow and, as with *A. ridleyi*, the crest is said to lack a central lobe. Unfortunately the material is quite inadequate for dissection.

25. *Amomum* sp. Merrill in Univ. Calif. Publ. Bot. 25:28 (1929).
SABAH: Sandakan, x-xii 1921, *Elmer* 20108 (UC, K).

Merrill allowed the duplicates of *Elmer* 20108 to be distributed under a new binomial commemorating the collector, but due to the incompleteness of the material it was never published. Dissection of the Kew sheet reveals a distinctly 3-lobed anther-crest, the central lobe being almost 4mm long, the laterals considerably shorter; details of labellum, staminodes etc. are impossible to distinguish clearly. The bracts are yellowish-brown, corolla yellow-white with a deeper yellow central patch and the fruit (n.v.) yellow-green. The species is presumably close to *A. flavo-album* and it is hoped that it may be recollected one day.

Excluded species:

- Amomum fimbriobracteatum* K. Schum = ***Geanthus fimbriobracteatus***
(K. Schum.) Burt & Smith.
Amomum havilandii K. Schum = ***Hornstedtia havilandii***
(K. Schum.) K. Schum.
Amomum nasutum K. Schum. = ***Acasma nasutum***
(K. Schum.) Loesen.
Amomum phaeochoana K. Schum. = ***Hornstedtia affinis***
Ridley.
Amomum pyramidosphaera K. Schum. = ***Nicolaia pyramidosphaera***
(K. Schum.) Burt & Smith.
Amomum reticulatum K. Schum. = ***Hornstedtia reticulata***
(K. Schum.) K. Schum.
Amomum stenosphon K. Schum. = ***Elettariopsis stenosphon***
(K. Schum.) Burt & Smith.
Amomum stoloniferum K. Schum. = ***Elettaria surculosa***
(K. Schum.) Burt & Smith.
Amomum surculosum K. Schum. = ***Elettaria surculosa***
(K. Schum.) Burt & Smith.



R.M.S.

FIG. 11. ?*Anomum* sp. A, Inflorescence $\times \frac{2}{3}$; B, bract $\times 1$; C, flower and bracteole within bract $\times 1$; D, bracteole $\times 1$; E, calyx, dissected $\times 1$; F, flower $\times 1$; G, flower, dissected $\times 1$; H, stamen $\times 2$; I, ovary in T.S. $\times 3$; J, K, young capsule, dorsal and lateral views $\times \frac{2}{3}$; L, young capsule in T.S. $\times \frac{2}{3}$ (from spirit material of Hansen 1080).

APPENDIX

?*Amomum* sp.—Fig. 11.

SARAWAK: 2nd Division, Lingga, G. Lesung, ridge top in hill dipterocarp forest, epiphyte, bracts red, 29 ix 1981, Hansen 1080 (C).

This striking plant is included in the present paper because of certain similarities to *Amomum sarawacense* and because it is hoped by thus doing, and providing an illustration, attention will be drawn to it and more information forthcoming. It is unclear from the above collection whether the inflorescence is radical or terminal on the leaf shoot and until this is known no decision on generic placement can be taken.

The large red bracts of the 14cm long cylindrical inflorescence have a *Curcuma*-like appearance but are quite free to the base. As in *A. sarawacense* the flowers are singly borne, each subtended by a boat-shaped bracteole and the slender corolla tube is long exerted from the calyx. It differs, however, in the lack of basal spurs to the anther-thecae, the truncate, shallowly 3-lobed anther crest and the narrow filament. Of most interest are the young capsules, which are more or less round when viewed dorso-ventrally, but flattened laterally to an extraordinary degree, becoming concave on the ventral surface. This plant certainly represents a new species, indeed possibly a new genus.

Gen. ignota

SARAWAK: 4th Division, Lambir National Park, Sungei Liam Libau, above main waterfall, on trunk over stream, bracts pink, flower white, red at base of lip and lower down, upper petal forming a hood, recurved at tip so flower seemingly bilabiate, 22 ix 1978, Burt 11590 (E).

Only a single, damaged flower remains on this problematic collection which may lie between *Amomum* and *Elettariopsis*. The inflorescence is cone-like with rigid bracts, each subtending at least two flowers, the bracteoles are open to the base and the leaf shoots reduced to two, rather coriaceous, blades, the uppermost with 2–3cm petioles the lower more or less sessile. These features indicated *Elettariopsis*, but other floral details are perhaps closer to *Amomum*; not, however, to the cincinni-bearing species of group I, which have distinctly tubular bracteoles and the anther-thecae fertile in the upper half only. In Burt 11590 the connective of the elongated anther-thecae is truncate and undulating; it does not, as far as may be distinguished, develop into a large prominent crest as in *Elettariopsis*. The stigma too, is as in most *Amomum*, i.e. more or less cup-shaped; that of *Elettariopsis* is always obconic with a wide, triangular mouth.

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